SUPPLEMENT TO
LABADIE ENERGY CENTER
DRAFT 316(A) DEMONSTRATION
IN RESPONSE TO AGENCY COMMENTS

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February 2020

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1. INTRODUCTION

Ameren Missouri submitted a draft 316(a) demonstration to Missouri Department of Natural Resources (MDNR) in August, 2019. Ameren subsequently received joint comments from MDNR and from the Missouri Department of Conservation (MDC), and also included feedback from Region VII of the United States Environmental Protection Agency (USEPA) and the United States Fish and Wildlife Service (USFWS). Ameren responses to the comments are provided in a separate response document (Response to Agency Preliminary Comments on Labadie Energy Center §316(a) Draft Demonstration dated 1/31/2020). This document provides supplementary materials directly requested in those comments or in response to the agency comments.

The document is organized around major themes in the comments, in particular

- Removal of Asian ~~C~~carp~~s~~ from data analysis
- Seasonal Trends in Heat-Intolerant Species
- Diversity calculations
- Effect of Family-level identifications in macrobenthos diversity analysis
- Use of Hester-Dendy (H-D) macrobenthos data combined across depths
- Use of Biotic Index in Analysis

2. REMOVAL OF ASIAN CARPS FROM DATA ANALYSIS

Several of the agency comments requested that statistical analysis of the fish data collected in 2017-2018 be redone after removal of Asian carps. The concern was that the ability to detect harm caused by the LEC thermal discharge would be masked by the presence of these invasive, and relatively heat-tolerant, species. Although guidance from USEPA on how community analysis for prior appreciable harm is to be conducted would not suggest that these species be removed, to accommodate the agency comments, the analyses in section 5.4.1 have been redone after removal of the Asian carp species (grass carp, bighead carp, and silver carp). Graphical analyses of individual metrics, along with the original result, are presented below. In addition, the distributions of the standardized differences based on all metrics across gear and seasons are also provided.

The analyses without Asian carps were consistently similar to those including Asian carps, leading to similar conclusions that the LEC thermal discharge has not caused prior appreciable harm to the community.

2.1 RELATIVE ABUNDANCE OF ASIAN CARPS

Despite the abundance of larval Asian carps in ichthyoplankton and entrainment collection, Asian carps comprised only a fraction of the fish community collected by fisheries sampling methods. In numerical abundance they comprised only 2% to 3% of the fish collected in each zone (Table 2-1). Because the grow rapidly and reach large sizes, the contribution to fish biomass was higher, but still only 5% in the discharge zone and 20% in the other zones.

Asians carp species individually were also not generally among the more common species. Table 2-2 below is a revised version of Table 5-3 of the demonstration, illustrating the 15 most common taxa in each zone. Silver carp are the only Asian carp species that was in the top 15 species, ranging from 10th most common in the Thermally Exposed zone to 13th most abundant in the Discharge zone. As indicated in Table 2-1, total abundance would only decline 2% to 3% with removal of Asian carps.

Table 2-1 Number and biomass of Asian carp species in each zone from fisheries sampling programs near the LEC during 2017-2018.

Taxon	Number of Fish				Biomass (kg)			
	Upstream Zone	Discharge Zone	Thermally Exposed Zone	Downstream Zone	Upstream Zone	Discharge Zone	Thermally Exposed Zone	Downstream Zone
Bighead carp	3	4	0	2	5.2	14.4	0.0	18.2
Silver carp	155	13	167	153	106.1	33.7	161.9	138.9
Grass carp	18	1	18	16	105.8	6.4	103.7	68.0
Asian carp Total	176	18	185	171	217.2	54.5	265.6	225.1
Total	9151	948	7105	8064	1084.3	1136.2	1318.8	1152.0
% Asian carp	2%	2%	3%	2%	20%	5%	20%	20%

Table 2-2 Species composition in each zone from fisheries sampling programs near the LEC during 2017-2018, as presented in draft Demonstration, and after removal of Asian carps. Differences noted by highlight or footnotes.

	Upstream Zone			Discharge Zone			Thermally Exposed Zone			Downstream Zone		
Rank	Taxon	Number	Fraction	Taxon	Number	Fraction	Taxon	Number	Fraction	Taxon	Number	Fraction
1	Red shiner	3,056a	0.334	Red shiner	330	0.348	Red shiner	1,291	0.182	Red shiner	1,824	0.226
2	Channel shiner	1,287	0.141	Blue catfish	154	0.162	Emerald shiner	914	0.129	Channel shiner	1,055c	0.130
3	Sicklefin chub	568	0.062	River carpsucker	67	0.071	Gizzard shad	757	0.107	Gizzard shad	980	0.122
4	Shoal chub	559	0.061	Emerald shiner	59	0.062	Channel shiner	743	0.105	Emerald shiner	636	0.079
5	Gizzard shad	557	0.061	Gizzard shad	56	0.059	Sicklefin chub	627	0.088	Shoal chub	631	0.078
6	Emerald shiner	495	0.054	Freshwater drum	46	0.049	Shoal chub	607	0.085	Sicklefin chub	472	0.059
7	Freshwater drum	487	0.053	Longnose gar	35	0.037	Freshwater drum	371	0.052	Bullhead minnow	286	0.035
8	Blue catfish	350	0.038	Shortnose gar	31	0.033	Blue catfish	282	0.040	Freshwater drum	275	0.034
9	Channel catfish	279	0.030	Flathead catfish	22	0.023	Channel catfish	242	0.034	Blue catfish	270	0.033
10	Bullhead minnow	255	0.028	Common carp	20	0.021	Silver carp	167	0.024	Channel catfish	256	0.032
11	Sand shiner	205b	0.021	Channel catfish	19	0.020	Bullhead minnow	104	0.015	Silver carp	153	0.019
12	Silver carp	155	0.017	Smallmouth buffalo	19	0.020	River carpsucker	100	0.014	Goldeye	141	0.017
13	Goldeye	115	0.013	Silver carp	13	0.014	Goldeye	90	0.013	Blacktail chubs	117	0.015
14	River carpsucker	74	0.008	Striped bass x white bass	12	0.013	Longnose gar	86	0.012	Mosquitofish	105	0.013
15	Longnose gar	66	0.007	Goldeye	11	0.012	Shortnose gar	86	0.012	Sand shiner	85d	0.010
New 15	Smallmouth buffalo	63		Channel shiner	10		Smallmouth buffalo	84		River carpsucker	77	
>15	56 additional taxa	662	0.072	22 additional taxa	54	0.057	56 additional taxa	638	0.090	53 additional taxa	782	0.097
	Total	9,151	1.000	Total	948	1.000	Total	7,105	1.000	Total	8,064	1.000
	Total without Asian carps	8,970		Total without Asian carps	930		Total without Asian carps	6,919		Total without Asian carps	7,886	

a Original total was 3,054; b Original total was 188; c Original total was 1,052; d Original total was 84

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2.2 OVERALL ABUNDANCE

Abundance of fishes within seasons and zones, and for each gear, were provided in the demonstration in Figures 5-12 (winter) and 5-13 (summer). Those figures are modified below to examine the effect of removal of Asian carps from the analysis. In both seasons, only Missouri Trawl catches exhibited a noticable change in numerical abundance (Figure 2-1 and Figure 2-2). Biomass was noticably reduced in at least one of the season in all gear except the bag seine, however the critical point is that the pattern of relative abundance among the four zones, and particularly for the Upstream Reference zone and the Downsteam zone remains the same, with or without Asian carps.

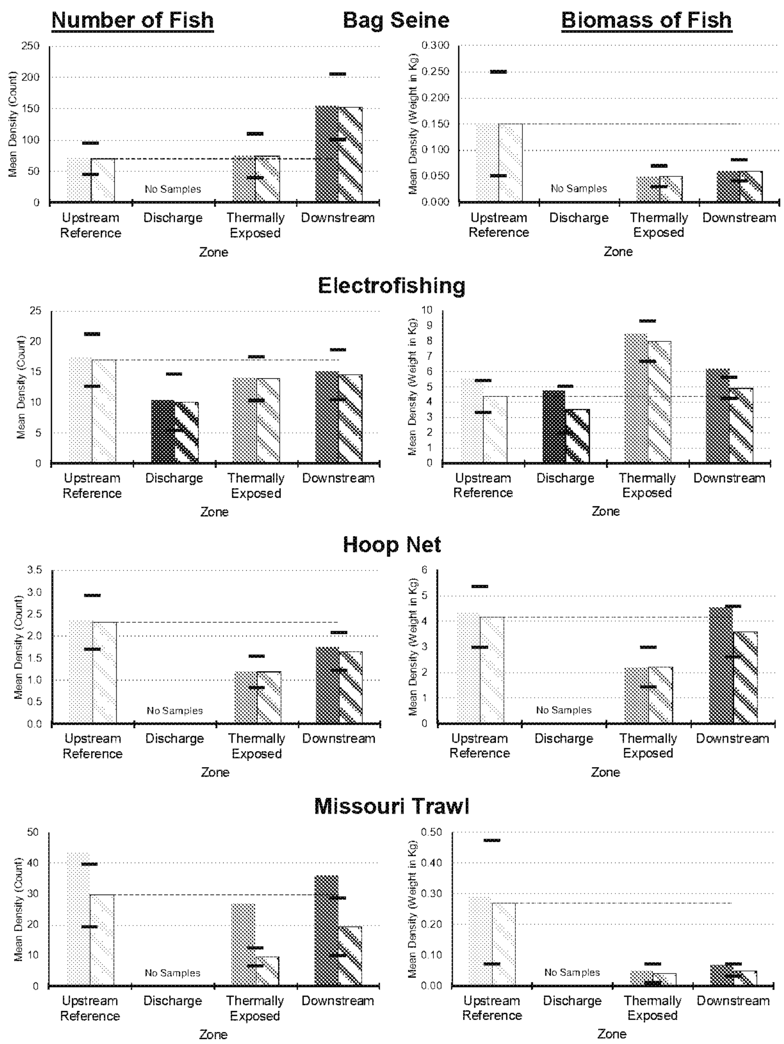


Figure 2-1 Summer mean density in fisheries sampling at the LEC in 2017-2018 for each gear type and zone, based on number of fish (left column) and biomass in Kg (right column). Solid color bars include Asian carps. Hatched bars exclude Asian carps. Black horizontal bars are +/- 1 standard error for mean without Asian carps.

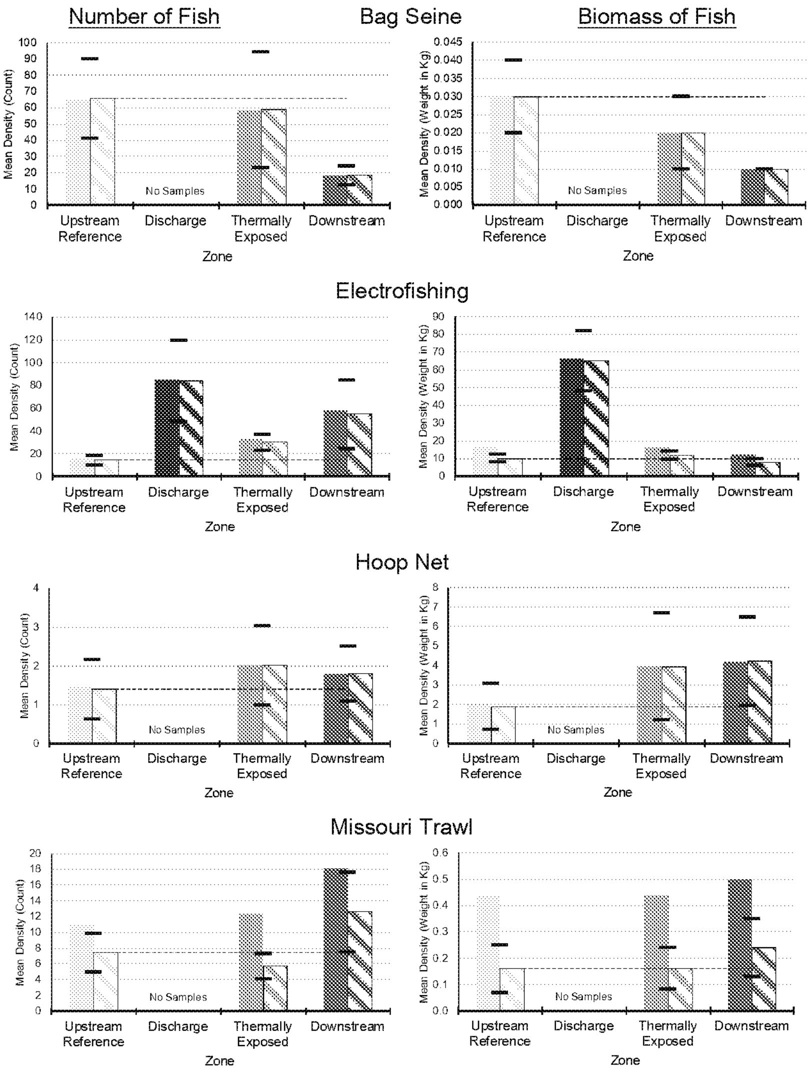


Figure 2-2 Winter mean density of fisheries sampling at the LEC in 2017-2018 for each gear type and zone, based on number of fish (left column) and biomass in Kg (right column). Solid color bars include Asian carps. Hatched bars exclude Asian carps. Black horizontal bars are +/- 1 standard error for mean without Asian carps.

2.3 COMMUNITY CHARACTERISTICS

2.3.1 Diversity

Diversity profiles were provided in the draft demonstration in Figure 5-15. The profiles are changed very little by removal of the three Asian carp species from the calculation (Figure 2-3), an unsurprising result since these species were only 2% to 3% of total numerical abundance and 5% to 20% of biomass. As with previous figures, the key comparison is not the change in any zonal profile, but the relationships among the profiles for each of the zones. Diversity relationships across zones do not change with or without Asian carps.

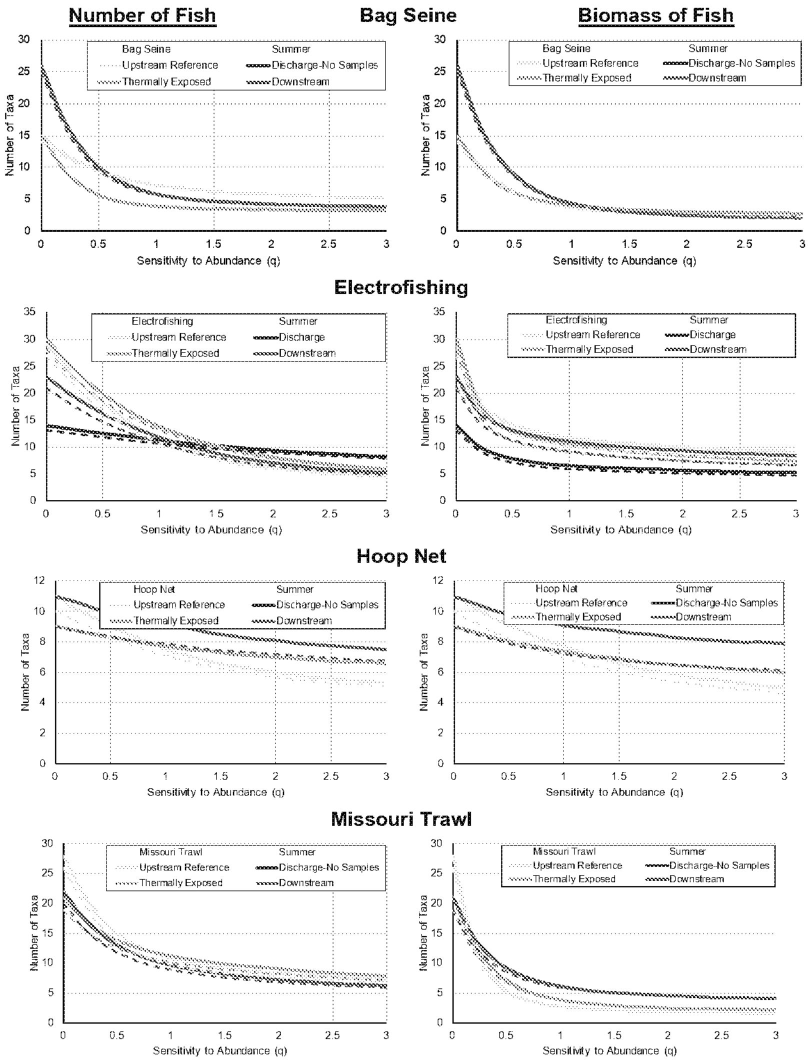
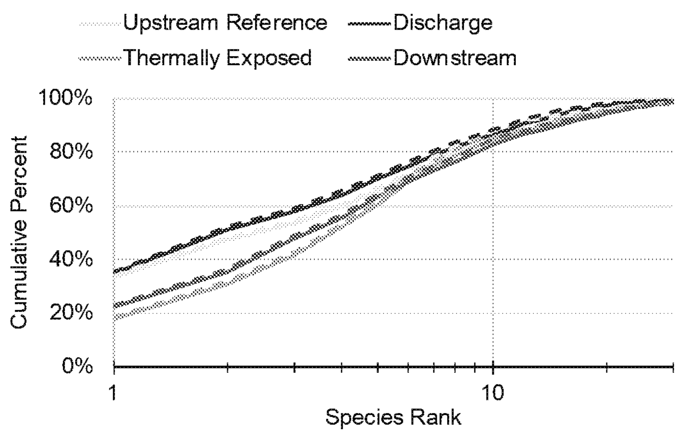


Figure 2-3 Summer diversity profiles of fisheries sampling at the LEC in 2017-2018 for each gear type and zone, based on number of fish (left column) and biomass in Kg (right column). Solid lines depict results including Asian carps. Dashed lines depict results without Asian carps.

2.3.2 Dominance

Dominance of the fish community was described in the demonstration in Figure 5-16. The figure was modified to examine dominance profiles with and without Asian carps (Figure 2-4). Dominance curves for numerical abundance changed very little when Asian carps were omitted. Biomass dominance was modified somewhat, but the relationships of dominance among the zones was the same.

Numerical Abundance



Biomass

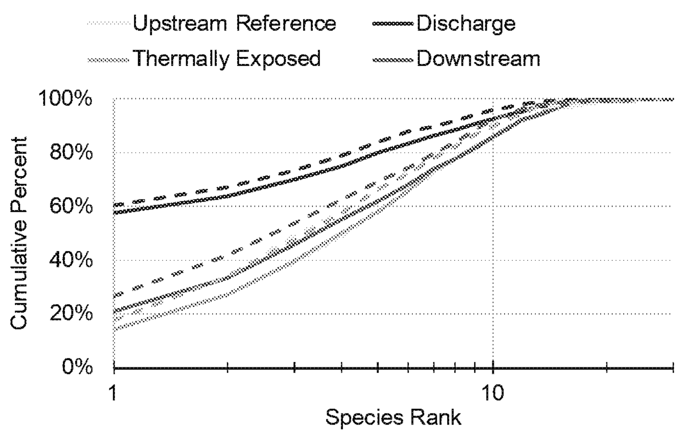


Figure 2-4 Dominance of the fish community in the LEC vicinity based on all sampling gears combined over all seasons, 2017-2018. Top figure is based on numerical abundance and bottom on biomass. Solid lines depict results including Asian carps. Dashed lines depict results without Asian carps.

2.4 COMMUNITY COMPOSITION

Composition of the fish community with respect to different fish categories (Rough, Forage, Panfish, Game, and Special Concern) was provided in Figure 5-18 of the demonstration. Forage and rough fish were the most prevalent numerically, and rough and game fish were most prevalent in terms of biomass. As a result of an agency comment, the analysis was redone after moving the buffalo species (subfamily Ictiobinae) to a Game/Commercial category. Figure 5-18 is revised to reflect this change in the demonstration. Figure 2-5 provides an alternative way to examine the breakdown of the community into these categories in terms of numbers and biomass, with and without the inclusion of Asian carps. It is apparent that the Asian carps have little effect on the community composition, or the differences in composition across zones.

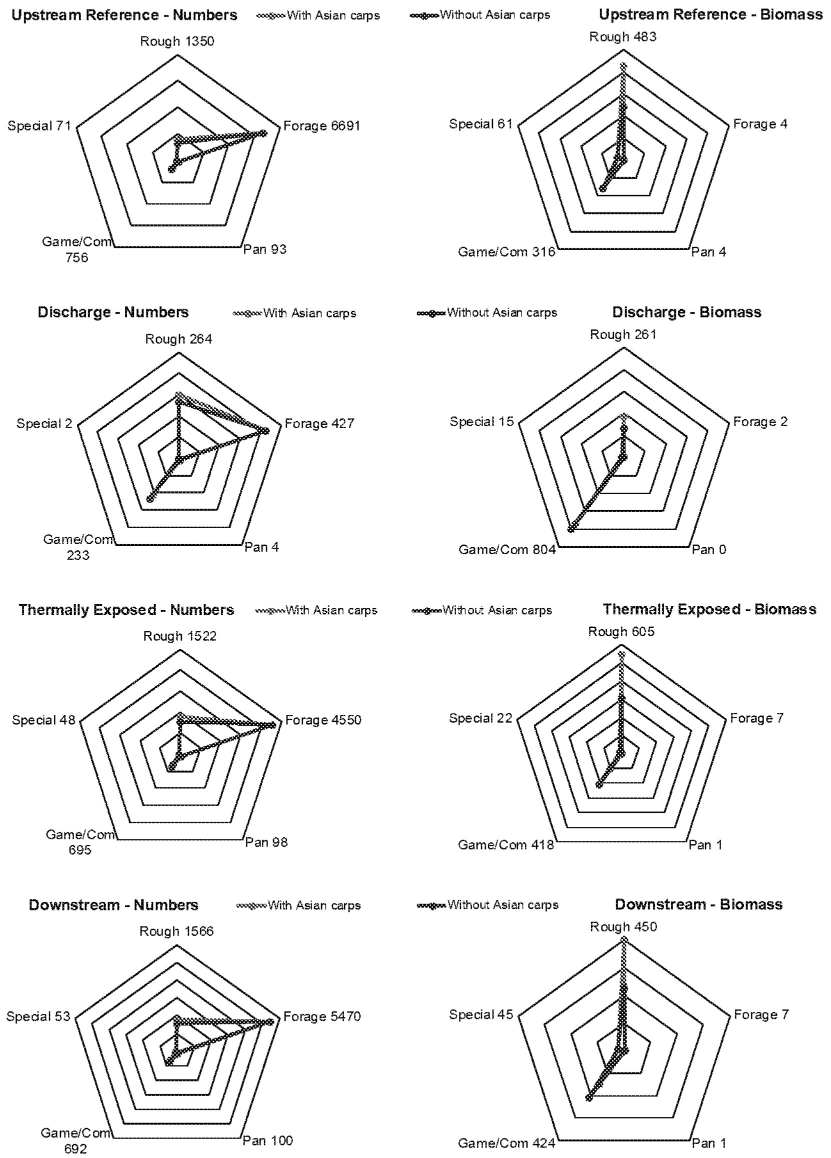


Figure 2-5 Composition of fisheries sampling results in rough, forage, pan, game/commercial, and special categories based on numerical abundance (left column) and total biomass in Kg (right) over all seasons and gear types.

2.4.1 Presence of all Trophic Levels

The breakdown of the community into trophic strategies was provided in Figure 5-17 of the demonstration. The relative frequencies of the different strategies changes little when Asian carps are removed from the analysis (Figure 2-6).

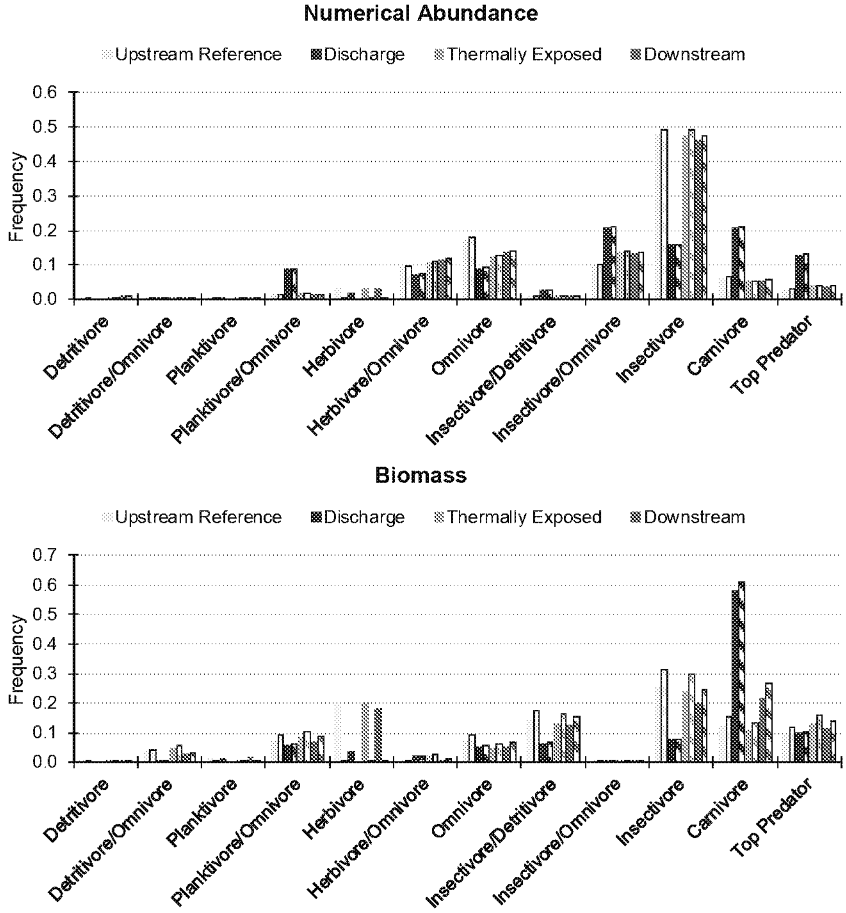


Figure 2-6 Trophic categories of the fish community sampled in the vicinity of the LEC in 2017-2018 based on all sampling gears over all seasons. Solid color bars include Asian carps. Hatched bars exclude Asian carps.

2.4.2 Heat Tolerance

The relative abundance of heat-intolerant and heat-tolerant species across the sampling zones was presented in Figure 5-19. Silver carp and bighead carp were included in the heat-tolerant species. The relative frequencies of heat-intolerant and heat-tolerant species changes little if Asian carps are removed (Figure 2-7), and in particular the patterns among the zones remain the same.

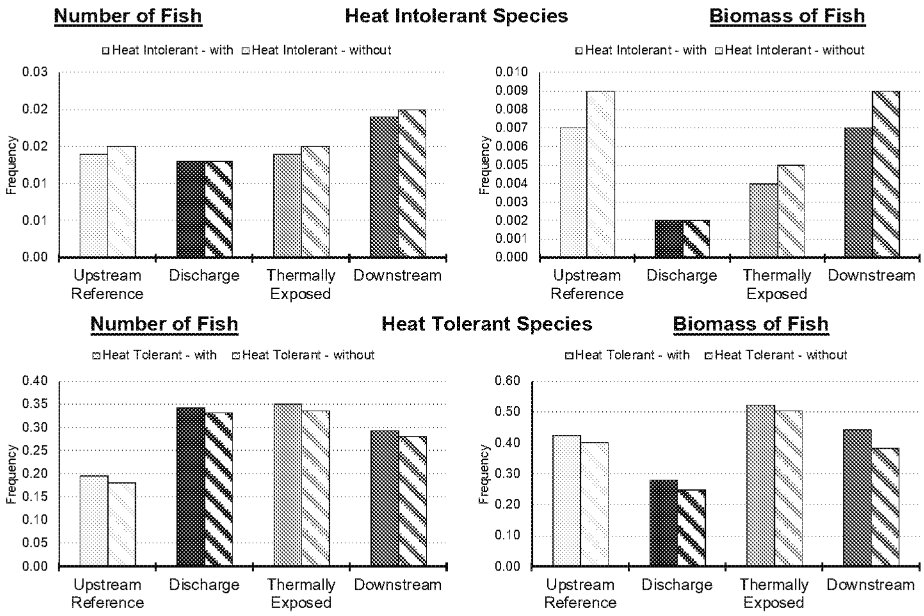


Figure 2-7 Fraction of the fish community in the vicinity of the LEC in 2017-2018 comprised of heat intolerant (top) and heat tolerant (bottom) species based on all sampling gears over all seasons. Solid color bars include Asian carps. Hatched bars exclude Asian carps.

2.4.3 Pollution Tolerance

The relative abundance of pollution-intolerant and pollution-tolerant species across the sampling zones was presented in Figure 5-20. According to Pearson et al. (2011), silver carp were included in the pollution-tolerant species. The relative frequencies of pollution-intolerant and pollution-tolerant species changes little if Asian carps are removed (Figure 2-8), and in particular the patterns among the zones remain the same.

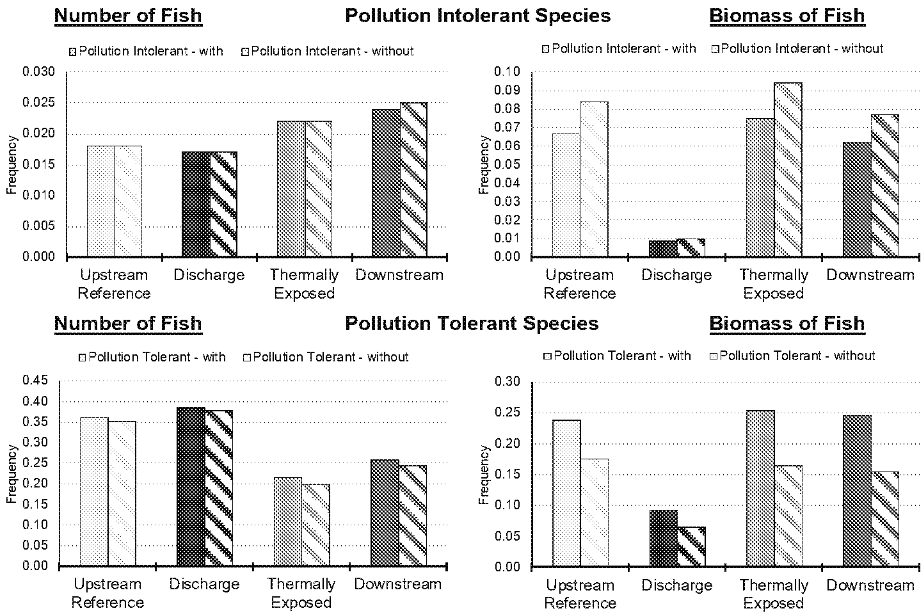


Figure 2-8 Fraction of the fish community in the vicinity of the LEC in 2017-2018 comprised of pollution intolerant (top) and pollution tolerant (bottom) species based on all sampling gears over all seasons. Solid color bars include Asian carps. Hatched bars exclude Asian carps.

2.5 OVERALL WEIGHT OF EVIDENCE

Due to the changes to the some of the individual metrics due to other agency comments (such as adding subfamily Ictiobinae to a Game/Commercial category) appropriate metrics were recalculated for the "with Asian carps" case, and Figure 5-22 of the demonstration has been updated in the revised demonstration. The recalculated standardized differences with and without Asian carps for zones 1 and 3 (Figure 2-9) and zones 1 and 4 (Figure 2-10) show little effect of Asian carp removal. For the zone 1 to 3 comparison, the mean is slightly less negative (-0.611 with Asian carp and -0.547 without), and for the zone 1 to 4 comparison, slightly more negative (-0.053 with Asian carp and -0.148 without). compare and all metrics were recalculated without Asian carps. However, in both cases, the means with or without Asian carps are close enough to zero that actual biological effects of the discharge, if any, are small.

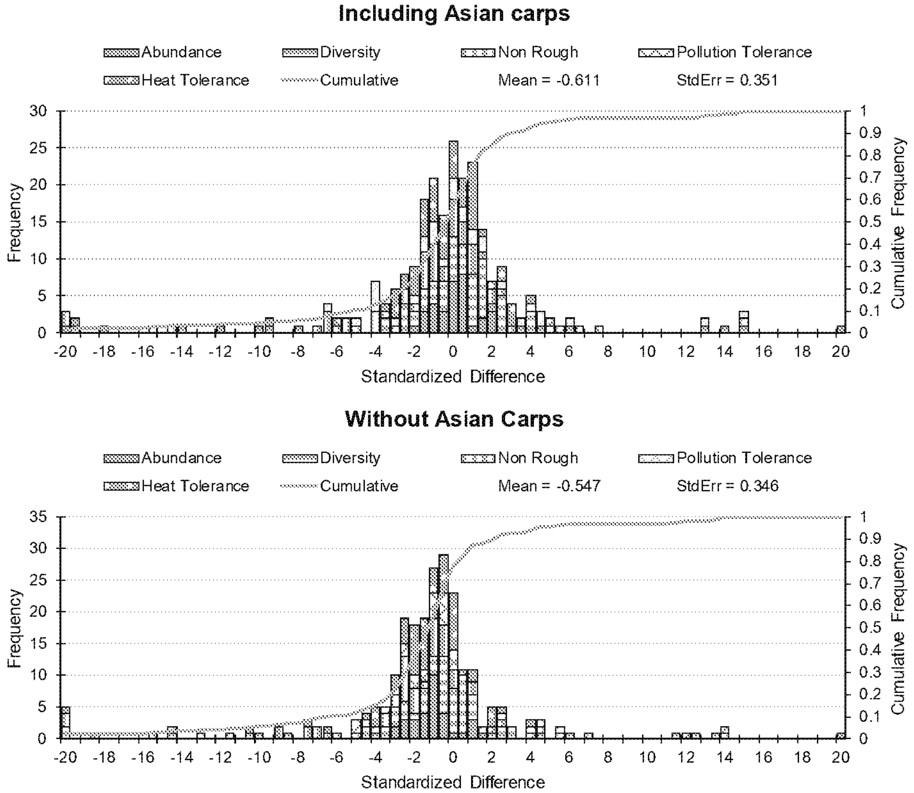


Figure 2-9 Distribution of standardized differences between ecological metrics for the Thermally Exposed Zone and Upstream Refence zone, including Asia carps (top) and without Asian carps (bottom) over all gear, seasons, and metrics.

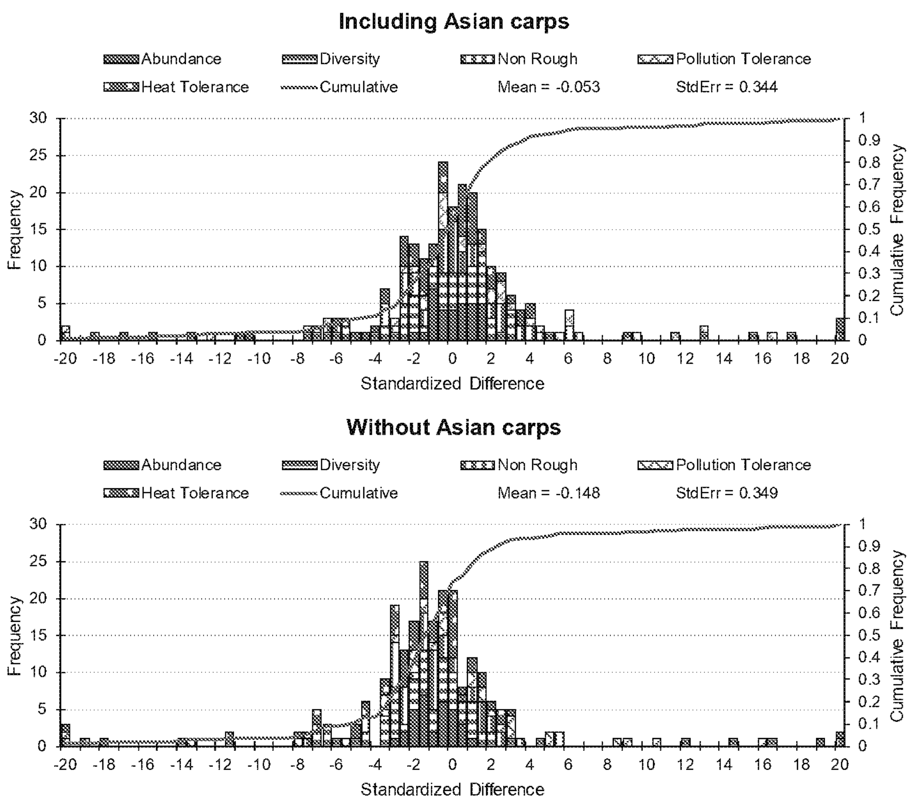


Figure 2-10 Distribution of standardized differences between ecological metrics for the Downstream Zone and Upstream Reference zone, including Asia carps (top) and without Asian carps (bottom) over all gear, seasons, and metrics.

3. SEASONAL TRENDS IN HEAT-INTOLERANT SPECIES

Commentors requested a graphical presentation that would demonstrate seasonal trends in heat-intolerant species. Figure 3-1 indicates that seasonal aspects of the abundance of heat-intolerant species is similar among the zones.

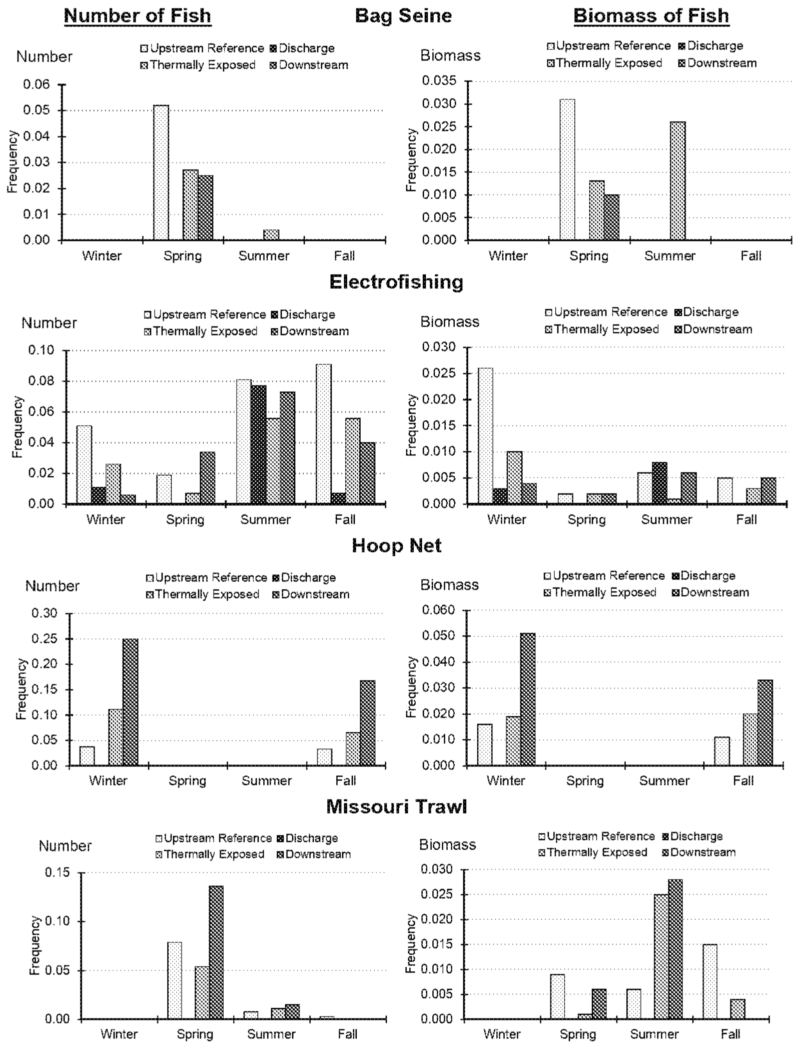


Figure 3-1 Seasonal fraction of the fish community comprised of heat-intolerant species as numbers (left) and biomass (right) in the vicinity of the LEC in 2017-2018.

4. DIVERSITY CALCULATIONS

Assume that a community consisting of S species with numbers of individual species denoted as $N_1, N_2, N_3, \ldots. N_S$ and N is the total number of organisms. The proportion of the community due to each species i is $p_i = \frac{N_i}{\sum_{i=1}^{S} N_i}$.

Hill numbers (Hill 1973) of order q, where q is a measure of the sensitivity of diversity to species abundance, denoted as ${}^{q}D$, are calculated as:

$${}^{q}D = \left(\sum_{i=1}^{S} p_i^{q}\right)^{\frac{1}{1-q}} \quad \text{where } q \geq 0 \text{, but } q \neq 1 \ldots\ldots \qquad [1]$$

Because the exponent $\frac{1}{1-q}$ would be undefined at q = 1, the limiting value as q→1 is substituted for equation [1]:

$${}^{q}D = \exp\left(-\sum_{i=1}^{S} p_i \log p_i\right) \quad \text{where } q = 1 \qquad [2]$$

The calculations describe a continuous smooth relationship between ${}^{q}D$ and q, given the particular values of p_i. When most of the organisms captured belong to just a few taxa, the curve declines sharply from its maximum value (S) at q = 0. If the community is more evenly dispersed among many taxa, the curve declines gradually. The diversity profile is interpretable as the number of equally abundant taxa that would be required to produce the same level of diversity at any particular level of sensitivity to abundance.

At q = 0, the diversity metric is completely insensitive to the relative abundance, and as would be expected, ${}^{0}D$ is equal to the species richness (S). When q = 1, the diversity metric is equivalent to exp(H´) where H´ is the Shannon-Weiner diversity. When q = 2, the diversity metric is equivalent to the inverse Simpson index.

q	Special Cases of Hill Numbers at q = 0, 1, 2	Corresponding Metric
0	${}^{0}D = \left(\sum_{i=1}^{S} p_i^{0}\right)^{\frac{1}{1-0}} = \left(\sum_{i=1}^{S} 1\right)^{1} = S$	Species Richness
1	${}^{1}D = \exp\left(-\sum_{i=1}^{S} p_i \log p_i\right) = \exp(H')$	exponential of Shannon Diversity
2	${}^{2}D = \left(\sum_{i=1}^{S} p_i^{2}\right)^{\frac{1}{1-2}} = \frac{1}{\sum_{i=1}^{S} p_i^{2}}$	inverse Simpson Diversity

For a sample of the community the calculated ${}^{q}D$ values are biased low in comparison to the true community values because some species that are present in the community may not be collected in the sample. This bias decreases with increasing sampling effort. As effort increases, more species are observed and therefore diversity could be expected to increase. Chao et al. (2014) provide the theoretical basis for estimating the asymptotic diversity if the habitat was completely sampled. For q = 0:

$${}^{0}\hat{D} = S_{obs} + \hat{f}_0 \qquad [3]$$

where S_{obs} is the number of species appearing at least once, and $\hat{f}_0$ is the estimated number of species present but not observed in the sample.

Uncertainty around the diversity profiles was assessed though a procedure, in which 1) the number of unsampled species is estimated; 2) the sampling probabilities of Sobs detected and $\hat{f}_0$ undetected species are estimated; 3) a bootstrap sample of the combined detected and undetected species of the original size n is taken; 4) the diversity profile is calculated from the bootstrap sample; 5) steps 3) and 4) are repeated 500 times; and 6) dispersion statistics are calculated for the 500 diversity profiles.

1) Chao et al. (2014) suggested the Chao1 estimator of $\hat{f}_0$:

$\hat{f}_0 = (n-1)f_1^2/(2nf_2)$, if $f_2 > 0$ [4a]

$\hat{f}_0 = \frac{(n-1)f_1(f_1-1)}{2n}$, if $f_2 = 0$, [4b]

where f_x is the number of species with exactly x organisms in the sample, and n is the total number of organisms sampled.

The sample coverage $\hat{C}$, is calculated as:

$\hat{C} = 1 - \frac{f_1}{n}\left[\frac{(n-1)f_1}{(n-1)f_1+2f_2}\right]$, if $f_2 > 0$ [5a]

$\hat{C} = 1 - \frac{f_1}{n}\left[\frac{(n-1)(f_1-1)}{(n-1)(f_1-1)+2}\right]$, if $f_2 = 0$ [5b]

If $\hat{C}$ = 1, then an alternative estimator was used (Gotelli and Colwell 2010) which divides the observed species into rare (S_{rare}) and abundant (S_{abund}) groups, based on ≤ 10 or > 10 organisms in the sample, and n_{rare} is the number of individuals of rare species:

$S_{rare} = \sum_{x=1}^{10} f_x$ [6a]

$S_{abund} = \sum_{x>10} f_x$ [6b]

$n_{rare} = \sum_{x=1}^{10} xf_x$ [6c]

In this case, the coverage and $\hat{f}_0$ are estimated as:

$\hat{C}_{ACE} = 1 - \frac{f_1}{n_{rare}}$ [7]

$\hat{\gamma}_{rare}^2 = \max\left\{\frac{S_{rare}}{\hat{C}_{ACE}}\frac{\sum_{x=1}^{10} x(x-1)f_x}{(n_{rare}-1)n_{rare}} - 1, 0\right\}$ [8]

$\hat{S} = S_{abund} + \frac{S_{rare}}{\hat{C}_{ACE}} + \frac{f_1}{\hat{C}_{ACE}}\hat{\gamma}_{rare}^2$ [9]

$\hat{f}_0 = \hat{S} - S_{abund} - S_{rare}$ rounded up to the next integer value [10]

2) The adjusted capture probabilities for the S_{obs} are

$$\hat{p}_i = \frac{x_i}{n}\left[1 - \hat{\lambda}\left(1 - \frac{x_i}{n}\right)^n\right]$$

where

$$\hat{\lambda} = \frac{1 - \hat{C}}{\sum_{x_i \geq 1} \frac{x_i}{n}\left(1 - \frac{x_i}{n}\right)^n}$$

and for the $\hat{f}_0$ unseen species are

$$\hat{p}_i = \frac{1 - \hat{C}}{\hat{f}_0}$$

3) A random sample of size n is drawn with replacement from the S_{obs} with probabilities $\hat{p}_1, \hat{p}_2, \hat{p}_3, \ldots\ldots \hat{p}_{S_{obs}}$, and from the $\hat{f}_0$ unseen species with probabilities $\hat{p}_{S_{obs+1}}, \hat{p}_{S_{obs+2}}, \hat{p}_{S_{obs+3}} \quad \ldots\ldots \hat{p}_{S_{obs+\widehat{f_0}}}$.

4) The diversity profile is computed for the sample using equations [1] and [2].

5) Steps 3) and 4) are repeated.

6) The standard deviations of the profiles are calculated at values of q at 0.1 intervals, and used to set approximate bounds (${}^qD$ +/ 2 standard deviations) for the profiles.

5. EFFECT OF FAMILY-LEVEL IDENTIFICATION ON MACROBENTHOS DIVERSITY ANALYSIS

Several comments questioned whether the use of family-level identification for the diversity analysis, rather than the lowest practical taxon, was potentially masking differences between zones. Although biotic indices, which use the same type of data to assess water quality within streams, often successfully use a higher level taxonomic specificity (Hilsenhoff 1987, Huggins and Moffet 1988), the original analyses have been replaced by analyses using the lowest practical taxon in the revised demonstration document. In addition, other analyses that tallied the number of taxa at particular levels of identification in the macrobenthic section (5.4.2) were also revised as described below.

The number of species observed was adjusted to include higher taxonomic categories if they did not include any organisms identified to species. For example, in Sample A in Table 4-1, the organisms identified only to family or genus are considered a species if there were no identified species within the classification (e.g. Family Hydrachnida, and genera *Chaoborus* and *Orthocladius*), while the genus *Nanocladius* does not represent a species in Sample A. In Sample B, the genus *Chaoborus* is not a species because *Chaoborus punctipennis* was present, but *Nanocladius* is considered a species because none of the genus were identified to a lower level. Because this method assigns only a single species to the higher taxonomic level, the number of species can be considered the minimum number of species. Similar considerations were applied to determine the number of genera, families, orders, etc.

Table 5-1 Example of species designations when organisms are identified to lowest practical taxon.

Identification as: Family – *Genus species*	Sample A		Sample B	
	Count	Considered as Species	Count	Considered as Species
Hydrachnida -	7	Yes	7	Yes
Chaoboridae – *Chaoborus sp.*	2	Yes	2	No
Chaoboridae – *Chaoborus punctipennis.*	0	-	2	Yes
Chironomidae - *Nanocladius*	13	No	20	Yes
Chironomidae - *Nanocladius alternantherae*	2	Yes	0	-
Chironomidae - *Nanocladius crassicornus*	6	Yes	0	-
Chironomidae - *Nanocladius distinctus*	33	Yes	0	-
Chironomidae - *Nanocladius minimus*	1	Yes	0	-
Chironomidae - *Orthocladius sp.*	1	Yes	1	Yes
Total Species in Sample		7		4

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Using this procedure, the number of species increased from the prior draft which provided only the number of "identified species", i.e. number of taxa for which genus and species could both be determined.

Because the analyses in 5.4.2 have all been revised to address the comment, detailed comparisons of the prior results with results based on lowest practical taxon are not provided here, except for an illustrative example of the diversity profiles (Figure 5-1). The number of taxa was increased, i.e. the diversity profile curves were shifted upward, but relationships among the four sampling zones was not substantially affected.

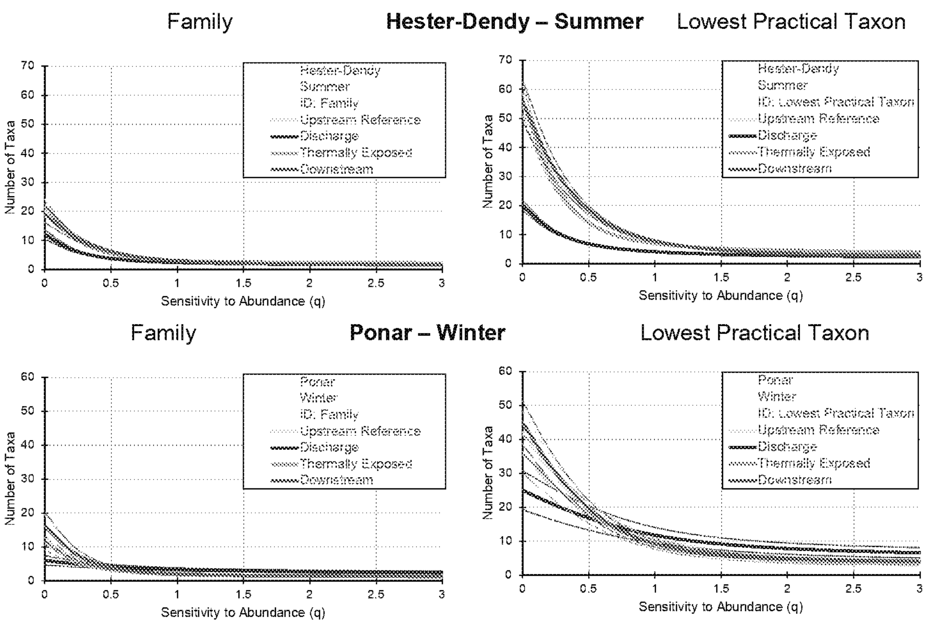

Figure 5-1 Diversity profiles of macrobenthos sampled at the LEC in 2017-2018 for Hester-Dendy sampling in summer (top) and Ponar sampling in winter (bottom). Level of taxonomic specificity is Family (left) and lowest practical taxon (right). Dashed lines for numerical profiles indicate +/- 2 standard deviations around estimate.

6. USE OF HESTER-DENDY MACROBENTHOS DATA COMBINED ACROSS DEPTHS

The following figures demonstrate the relative similarity between mean density among the mid-depth and bottom macrobenthic collecitons on a seasonal basis. Figures are also presented that illustrate the relative similarity among the dominant taxonomic orders. Additionally, Attachment A provides more detail regarding the taxonomic composition and the relative similarity between these two groups of macrobenthic data. Results in Figure 6-1 and Figure 6-2 indicate that a high degree of similarity among data collections from the mid-depth and the benthic H-D macrobenthic samples, thereby supporting the aggregation of these data sets as part of the thermal demonstration analysis.

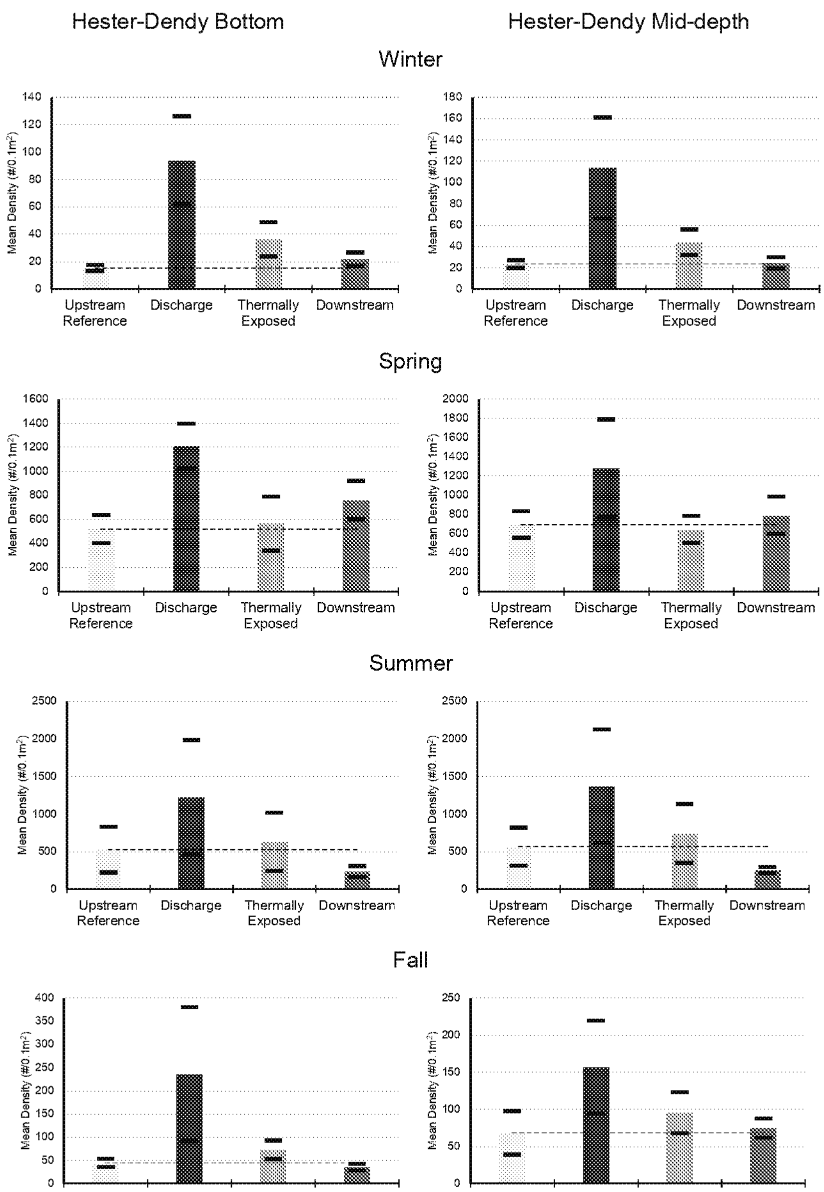

Figure 6-1 Mean density (#/0.1m^2) of Hester-Dendy sampling of macrobenthos at the LEC in 2017-2018 for each season, and zone. Bottom and mid-depth samples shown separately. Back bars indicate +/- 1 standard error from mean.

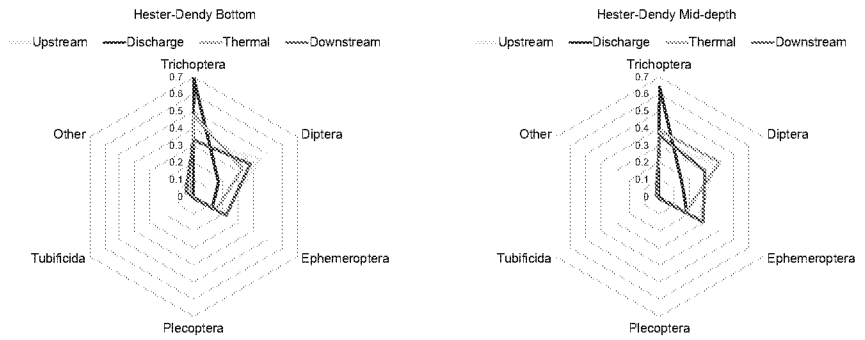

Figure 6-2 Contribution of major orders to the macrobenthos sampled by Hester-Dendy samplers on the bottom (left) and at mid-depth (right).

7. BIOTIC INDEX

The Biotic Index (BI) of mid-depth and bottom-depth H-D samplers was also similar among each of the sampling zones during each season (see Attachment A, Table A-7). While slightly lower BI values were observed in the spring for each of the sampling zones, the BI values were relatively consistent, ranging from 4.22 in the discharge zone in spring to 5.51 for the upstream reference zone in summer (Figure 7-1, Table A-7). Overall, no statistically significant differences were observed among BI values for mid-depth and bottom-depth H-D samplers (t-stat = -0.47, df = 30, p-value = 0.64).

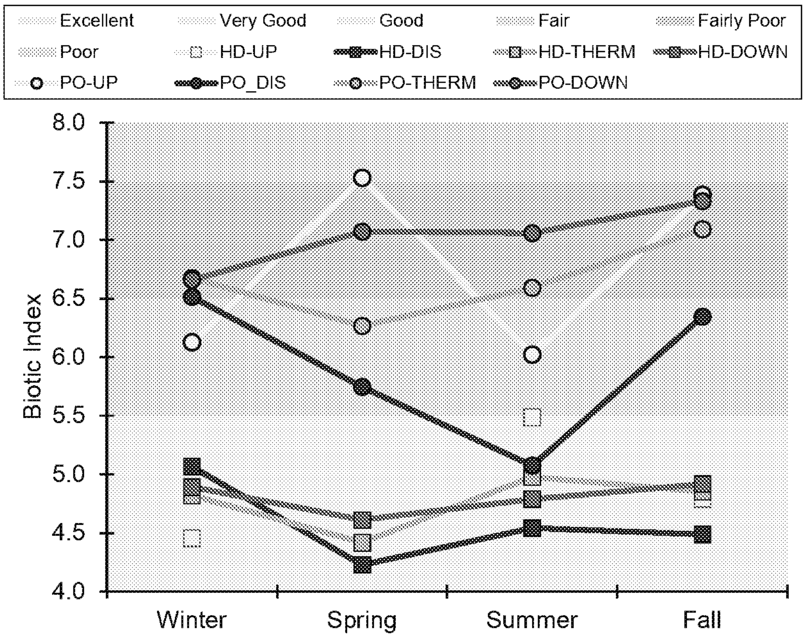

Figure 7-1 Biotic index for Hester-Dendy (squares) and Ponar (circles) sampling at LEC 2017-2018, by season and zone

8. BENTHIC INVERTEBRATE SAMPLE PROCESSING AND QA/QC

Benthic Macroinvertebrate Sample Processing

Standard ponar dredge samples were sieved in the field using a 0.5-mm mesh bucket sieve. The remaining organisms, detritus, debris, and sediments from the sieve bucket were carefully removed from the sieve and placed into a sample container and preserved in 10 percent formalin solution with Rose Bengal stain.

Hester-Dendy samplers were retrieved and placed in individual sample containers containing 10 percent formalin solution with Rose Bengal stain and transported back to Wood's Ecology Laboratory for processing. In the laboratory, sampler plates were removed and carefully scraped to remove all organisms. Each sample container was also sieved using a No. 35 (0.5- mm mesh) sieve to collect any organisms dislodged during transport.

All ponar and H-D samples were returned to Wood's Ecology Laboratory and processed according to procedures set forth for Laboratory Sample Processing in the "*Standard Operating Procedures for the Ameren Missouri Labadie Energy Center 316(a) Program Field Sampling and Analysis*" (AmecFW 2018).

Invertebrates were sorted following the same sorting procedures as ichthyoplankton except invertebrates were split into three different vials to facilitate the identification process. The three vials contained the following taxonomic "processing groups": (1) Oligochaeta; (2) Chironomidae; and (3) other taxa (e.g., crustaceans, other insects, mollusks). Contents of each sample were thoroughly rinsed into a No. 35 size sieve having 500-μm mesh. All invertebrates were sorted from the sample using a 10X magnifying lamp and submitted for taxonomic analysis. If H-D and Ponar samples contained a large number of specimens then samples were split using a Folsom plankton splitter. Sub-samples were then processed until a minimum of 200 specimens were found. Counts for individual sub-samples were maintained in the event that multiple sub-samples were required to reach a total of 200 specimens or in the event that an initial sub-sample containing more than 200 specimens was split a second time. The identifications of specimens in the sub-sample that contained a minimum of 200 specimens was multiplied by the appropriate split factor (2^x, where x = the number of times the sample was split) to obtain the total number of individuals in the sample. The remainder of the sub-samples were also examined for the presence of potential large and rare taxa. These specimens, if present, were not included in the split factor calculation.

All taxonomic identifications were done using stereoscopes with a polarized light set-up. For organisms mounted on slides (midges and worms) a compound microscope was used with phase contrast. If the numbers of organisms in samples were high from the sorting process (> 400 organisms) appropriate actions were taken to split the sample. A target of 200 (- 10 percent) identified organisms was established across all taxonomic processing groups for the entire sample. If a sample was dominated by Oligochaeta or Chironomidae (> 100 organisms in each group) appropriate actions were taken to split the individual vials. To ensure that the target number of identified organisms was achieved, the Laboratory Manager or their designee verified that the total count was achieved across all taxonomic processing groups (i.e., Others, chironomids, oligochaetes). Based on this review the Laboratory Manager or their designee allowed the splitting of discrete taxonomic processing groups such that the sum of all organisms identified from all groups achieved the target value. Prior to identification, midges and worms were mounted on slides using PVA or CMCP-10, depending on availability. All identifications were made to the lowest practical taxonomic level, usually genus or species. Damaged or partial specimens were counted as part of the sample, using the convention of counting heads or bodies, ensuring an individual was not counted twice. Macroinvertebrate exuviae were not counted. A reference collection of each taxon was maintained.

Quality Assurance/Quality Control

A detailed description of the Quality Assurance Project Plan (QAPP) that addresses quality assurance and quality control (QA/QC) requirements for the biological monitoring program and environmental measurements and information that was collected can be found in the "*Quality Assurance Project Plan for the Ameren Labadie Energy Center 316(a) Program*" (AmecFW 2016).

The SOP and QAAP were prepared prior to the start of sampling and were followed throughout the study to ensure that the data generated met specified quality standards that include precision, accuracy, completeness, representativeness, and comparability. All project staff were highly qualified for their tasks and trained specifically for adherence to the SOPs and any additional aspects of the program, such as equipment operation, site security, and safety procedures as described in the Health and Safety Plan (HASP) (AmecFW 2017). In addition, periodic auditing of data collection activities performed in the field and laboratory were conducted by senior personnel from Wood and ASA to ensure that the protocols and procedures were being followed correctly. Systematic QC procedures were also instituted to verify recorded data. The primary areas where these QC procedures were employed was during calibration of instruments and for sample processing (e.g., sample sorting, species identification, and length measurements). A Continuous Sampling Plan, Type-1 (CSP-1) was implemented under these procedures that had a specified average outgoing quality limit (AOQL) of 5 percent, which represents the maximum fraction of all items (e.g., taxonomic identifications, measurements) or lots (e.g., whole samples) that could be defective as a worst case (i.e., no more than 5 percent of samples could fail to meet acceptance criteria). Samples that did not achieve the specified 95 percent acceptance criteria were rejected and reprocessed according to prescribed CSP-1 procedures. A 10 percent identification check was followed for the QA/QC assessment of macroinvertebrate specimen identification. Ten percent of samples that were identified by each taxonomist were processed for a QA/QC check by a second qualified taxonomist. Subsets of ten samples were designated for the QA/QC check, with one of the ten samples randomly picked to be the QA/QC sample. The original taxonomist must correctly identify 95 percent of the organisms comprising the sample in order to pass the QA/QC check. If a taxonomist fails a QC inspection, then the remaining samples within that subset of ten samples will be re-examined by the original taxonomist and also undergo another QA/QC check by a second qualified taxonomist. If these samples continue to fail inspection, then previous samples identified by the original taxonomist will undergo QC checks until 95 percent accuracy is achieved. A reference collection of voucher specimens was also maintained and independently verified by another taxonomist, with outside verification by a third party as needed. Any rare specimens or specimens of threatened or endangered species required additional verification and were sent to an outside recognized taxonomic expert for confirmation.

Data verification and validation of field data was conducted by qualified biologists (e.g., QA manager or field/lab supervisors) during the course of the project to ensure that the resulting data was suitable for use as intended. Project records, including field sampling logs, raw data sheets, sample COC forms and instrument calibration logs, were reviewed to verify that data were collected according to the QAPP. Data was validated first by a review of datasheets and data files to find whether data were incomplete or appeared to be inappropriate or out of a reasonable range of values. The field data were initially entered into a project developed Access database and were reviewed by a second individual for accuracy and completeness. Data entry into the database underwent a 100 percent visual QC comparison to the data on the corresponding data sheets. Finally, data files were subjected to error checking programs to detect outlying values either to investigate further or to eliminate if shown to be spurious. This investigation required tracing the data to raw data sheets and consulting with field or lab personnel who recorded the data. All raw data sheets, log books, and data files were maintained for future reference. All computer files were backed up on a daily basis while any data entry or editing procedures were ongoing. Reports were generated from the database and/or from database information exported into Excel for reporting or calculation/statistical purposes. The data reports generated from the database were checked at a 20 percent frequency to ensure that the programs were performing correctly. Similarly, statistical analysis performed on the data from the database were checked by verification of calculations to ensure validity of the analysis findings. All electronic files (data, database, reports, etc.) were stored on the office local area network under the project number in an appropriately named subdirectory. Original field logbooks and any additional raw data were maintained in the project files located in the office central files under the project number.

References

Amec Foster Wheeler Environment & Infrastructure, Inc. (AmecFW). 2016. Quality Assurance Project Plan for the Ameren Missouri Labadie Energy Center 316(a) Program. Prepared for Ameren Missouri, St. Louis, MO. Prepared by AmecFW. August 2016.

Amec Foster Wheeler Environment & Infrastructure, Inc. (AmecFW). 2017. Health and Safety Plan for the Ameren Labadie 316(a) Program. Prepared for Ameren Missouri, St. Louis, MO. Prepared by AmecFW. January 2017.

Amec Foster Wheeler Environment & Infrastructure, Inc. (AmecFW). 2018. Standard Operating Procedure for the Ameren Missouri Labadie Energy Center 316(a) Program Field Sampling and Analysis. Prepared for Ameren Missouri St. Louis, MO. Prepared by AmecFW. April 2018. Revision 3.

9. SEDIMENT GRAIN SIZE

In conjunction with the response to MDNR Comment 29.a, qualitative sediment characterization (percent abundance of particle types) of individual macroinvertebrate samples collected by ponar grab as per the study plan are included below.

Ameren MISSOURI

Labadie Energy Center
316(a) Thermal Demonstration

wood.

Sampling Method: Ponar

Sample ID	Date	Total Effort	Surface Temp	Bottom Temp	Surface DO	Bottom DO	Surface Turbidity	Bottom Turbidity	Depth	Grain Size
LAB-PN-1-IWD-0-01	3/28/2107	0.156	12.7	12.4	10.4	9.6	32.3	50.6	4	80% fine silt, 20% clay
LAB-PN-1-IWD-0-02	6/27/2017	0.156	25.5	25.5	5.94	5.71	171	178		30% fine silt, 55% medium silt, 10% fine sand, 5% clay
LAB-PN-1-IWD-0-03	9/19/2017	0.156	24.3	24	9.7	9	24	48.2		95% fine sand, 4% medium snad, 1% clay
LAB-PN-1-IWD-0-04	11/14/2017	0.156	6.5	8.3	14.01	13.8	13.01	20.1		5% clay, 25% fine silt, 70% medium silt
LAB-PN-1-IWD-0-05	3/13/2018	0.156	5.6	5.5	11.09	10.98	98.9	119	3.5	60% clay, 20% fine silt, 20% medium silt
LAB-PN-1-IWD-0-06	6/4/2018	0.156	24.8	24.8	6.85	6.75	68.3	66.7	4	15% fine sand, 40% medium silt, 45% clay
LAB-PN-1-IWD-0-07	8/29/2018	0.156	26	26.2	7.21	6.74	227	264	3	10% clay, 90% fine silt
LAB-PN-1-IWD-0-08	12/10/2018	0.156	1.7	1.7	15.83	15.49	308	323	4	50% fine sand, 40% fine silt, 10% clay
LAB-PN-1-OLD-0-01	3/28/2017	0.156	12.4	12.5	10.4	9.9	47.7	48.1	5	5% fine sand, 35% clay, 60% medium silt
LAB-PN-1-OLD-0-02	6/27/2017	0.156	25.3	25.3	6.51	6.49	195	204		80% clay, 19% fine silt, 1% fine sand
LAB-PN-1-OLD-0-03	9/19/2017	0.156	24.1	24.1	9.2	8.64	24.1	35.2		45% fine sand, 45% silt, 10% gravel
LAB-PN-1-OLD-0-04	11/14/2017	0.156	8.2	8.2	14.04	14.1	23.5	26.3		2% gravel, 3% course sand, 30% clay, 65% fine silt
LAB-PN-1-OLD-0-05	3/13/2018	0.156	5.5	5.5	11.46	11.07	77.8	72.5	4.5	5% clay, 5% coasre gravel, 20% coarse sand, 70% fine silt
LAB-PN-1-OLD-0-06	6/4/2018	0.156	24.6	24.6	6.68	6.57	66.9	69.6	2.5	30% fine silt, 70% clay
LAB-PN-1-OLD-0-07	8/29/2018	0.156	26.2	26.3	6.8	6.75	165	220	3	15% fine sand, 15% clay, 70% fine silt
LAB-PN-1-OLD-0-08	12/10/2018	0.156	1.7	1.7	15.65	15.46	330	312	5	60% clay, 30% medium silt, 10% fine sand
LAB-PN-1-CXLD-0-01	3/28/2017	0.156	12.5	10.8	10.4	8.8	40.1	53.6	6	1% medium sand, 60% clay, 39% fine silt
LAB-PN-1-CXLD-0-02	6/27/2017	0.156	25.4	25.4	5.72	5.98	182	210		60% clay, 38% fine silt, 2% fine sand
LAB-PN-1-CXLD-0-03	9/19/2017	0.156	24.2	24.1	9.51	8.96	35.5	123		60% clay, 30% fine silt, 10% fine sand
LAB-PN-1-CXLD-0-04	11/14/2017	0.156	8.2	8.4	12.9	12.9	20.1	24.9		20% clay, 5% fine silt, 75% medium silt
LAB-PN-1-CXLD-0-05	3/13/2018	0.156	5.6	5.5	11.28	10.28	88.6	100	3.5	40% clay, 30% fine silt, 30% silt
LAB-PN-1-CXLD-0-06	6/4/2018	0.156	24.7	24.7	6.85	6.68	66.4	72.9	3	20% fine sand, 15% fine silt, 65% clay
LAB-PN-1-CXLD-0-07	8/29/2018	0.156	26.2	26.2	7.08	6.63	116	187	3	5% find sand, 25% clay, 70% fine silt
LAB-PN-1-CXLD-0-08	12/10/2018	0.156	1.7	1.7	15.77	15.41	318	310	4	40% clay, 20% fine sand, 40% fine silt
LAB-PN-2-DIS-0-01	3/28/2017	0.156	18.9	18.8	10.3	10.1	60.6	58.4	6	20% medium silt, 80% clay
LAB-PN-2-DIS-0-02	6/27/2017	0.156	34.1	34	5.32	5.12	286	252		10% clay, 5% fine silt, 84% medium silt, 1% fine sand
LAB-PN-2-DIS-0-03	9/19/2017	0.156	33	32.9	9.7	9.68	42.5	44.9		80% medium silt, 20% clay
LAB-PN-2-DIS-0-04	11/14/2017	0.156	23	22.4	11.6	11.8	29.7	31.1		40% clay, 60% medium lilt
LAB-PN-2-DIS-0-05	3/13/2018	0.156	19.6	19.6	9.36	9.36	137	137	3	2% fine sand, 58% medium silt, 40% clay
LAB-PN-2-DIS-0-06	6/4/2018	0.156	32.8	32.7	6.21	6.19	77.1	77	2.5	40% clay, 60% medium silt
LAB-PN-2-DIS-0-07	8/29/2018	0.156	37	36.9	7.09	7.07	270	291	2	70% clay, 30% fine silt
LAB-PN-2-DIS-0-08	12/10/2018	0.156	16.2	16.2	13.98	12.82	315	333	5	60% fine sand, 35% fine silt, 5% clay

Sample ID	Date	Total Effort	Surface Temp	Bottom Temp	Surface DO	Bottom DO	Surface Turbidity	Bottom Turbidity	Depth	Grain Size
LAB-PN-3-IWD-0-02	6/28/2017	0.156	26.4	26.4	5.99	5.61	168	190		80% clay, 19% fine silt, 1% fine sand
LAB-PN-3-IWD-0-03	9/20/2017	0.156	25.6	25.5	9.21	9.02	25.6	39		50% silt, 40% clay, 10% fine sand
LAB-PN-3-IWD-0-04	11/15/2017	0.156	11	10.9	13.5	13.5	18.9	22.1		3% fine sand, 27% clay, 70% fine silt
LAB-PN-3-IWD-0-05	3/14/2018	0.156	7.8	7.9	10.74	10.59	146	172	3.5	85% clay, 1% fine sand, 14% fine silt
LAB-PN-3-IWD-0-06	6/5/2018	0.156	26.1	26	7.05	6.85	80.8	89.9	2.5	20% clay, 80% fine silt
LAB-PN-3-IWD-0-07	8/30/2018	0.156	27.4	27.4	7.05	6.88	176	212	2	10% clay, 25% fine sand, 65% fine silt
LAB-PN-3-IWD-0-08	12/11/2018	0.156	2.7	2.7	17.32	15.49	238	244	4	40% clay, 55% fine silt, 5% fine sand
LAB-PN-3-OLD-0-01	3/28/2017	0.156	14.6	14.6	10.4	10.4	52.5	51.7	4	10% coarse sand, 1% pebbles, 60% clay, 29% medium silt
LAB-PN-3-OLD-0-02	6/27/2017	0.156	27.3	27.3	5.8	5.5	265	246		5% clay, 55% medium silt, 40% fine sand
LAB-PN-3-OLD-0-03	9/19/2017	0.156	26.1	26	9.73	9.68	37.9	39.8		84% silt, 10% medium sand, 5% coarse sand, 1% clay
LAB-PN-3-OLD-0-04	11/14/2017	0.156	11.4	11.5	13.8	13.7	27.9	28.7		10% clay, 3% fine sand, 20% medium silt, 67% fine silt
LAB-PN-3-OLD-0-05	3/13/2018	0.156	9.5	9.5	10.92	10.55	115	128	3.5	80% clay, 20% medium silt
LAB-PN-3-OLD-0-06	6/4/2018	0.156	26.9	26.9	6.8	6.72	70.3	78.3	3.5	30% medium silt, 70% clay
LAB-PN-3-OLD-0-07	8/29/2018	0.156	28.1	28.1	7.28	7.13	271	288	2	15% clay, 85% fine silt
LAB-PN-3-OLD-0-08	12/10/2018	0.156	3.8	3.8	14.89	14.9	325	327	4	80% fine silt, 15% fine sand, 5% clay
LAB-PN-3-CXLD-0-01	3/28/2017	0.156	14.4	14.3	10.1	7.7	40.3	54.6	4	40% clay, 60% fine silt
LAB-PN-3-CXLD-0-02	6/27/2017	0.156	27.4	27.3	4.97	5.01	148	162		70% clay, 15% medium silt, 14% fine silt, 1% fine sand
LAB-PN-3-CXLD-0-03	9/19/2017	0.156	26.4	26.3	10.1	9.99	18.8	25.9		84% fine silt, 15% clay, 1% fine sand
LAB-PN-3-CXLD-0-04	11/14/2017	0.156	11	11	13.6	13.7	22.9	21.2		10% fine silt, 90% medium silt
LAB-PN-3-CXLD-0-05	3/14/2018	0.156	8.4	8.4	10.45	10.48	96.1	113	3.5	10% clay, 20% medium silt, 70% fine silt
LAB-PN-3-CXLD-0-06	6/4/2018	0.156	26.6	26.6	6.77	6.67	49	67	3	30% clay, 70% fine silt
LAB-PN-3-CXLD-0-07	8/29/2018	0.156	27.6	27.6	7.2	6.83	162	209	3	30% clay, 70% fine silt
LAB-PN-3-CXLD-0-08	12/10/2018	0.156	3	3	13.65	13.47	239	215	4	50% clay, 45% fine silt, 5% fine sand
LAB-PN-4-IWD-0-01	3/29/2017	0.156	13.6	13.6	10.4	10.3	59	59.8	4	80% fine silt, 20% clay
LAB-PN-4-IWD-0-02	6/28/2017	0.156	26.2	26.2	5.97	5.62	171	196		5% clay, 10% fine sand, 70% medium silt, 15% fine silt
LAB-PN-4-IWD-0-03	9/20/2017	0.156	26	25.7	10.41	10.28	21	37.4		99% silt, 1% clay
LAB-PN-4-IWD-0-04	11/15/2017	0.156	9.9	9.8	13.9	13.7	13.9	20.6		5% clay, 25% medium silt, 70% fine silt
LAB-PN-4-IWD-0-05	3/14/2018	0.156	7.2	6.9	10.92	10.77	116	111	3.5	50% clay, 50% fine silt
LAB-PN-4-IWD-0-06	6/5/2018	0.156	25.8	25.6	6.96	6.48	56.5	63.8	3	2% fine sand, 18% clay, 80% fine silt
LAB-PN-4-IWD-0-07	8/30/2018	0.156	26.9	26.9	6.93	6.62	147	172	2	20% fine sand, 80% fine silt
LAB-PN-4-IWD-0-08	12/11/2018	0.156	2.2	2.2	17.2	15.6	228	227	3	60% medium silt, 30% clay, 10% fine silt
LAB-PN-4-OLD-0-01	3/29/2017	0.156	13.6	13.6	10.2	9.9	54.6	56.1	4	60% silt, 25% clay, 10% sand, 5% fine/medium pebbles
LAB-PN-4-OLD-0-02	6/28/2017	0.156	26	26	5.45	5.28	161	175		85% clay, 14% fine silt, 1% sand
LAB-PN-4-OLD-0-03	9/20/2017	0.156	25.1	25	10.17	10.11	19.8	20.9		50% fine silt, 49% clay, 1% medium sand
LAB-PN-4-OLD-0-04	11/15/2017	0.156	9.9	9.9	13.8	13.6	14.4	17		5 % fine sand, 10% clay, 20% fine silt, 65% medium silt
LAB-PN-4-OLD-0-05	3/14/2018	0.156	7.1	7.1	10.87	10.74	182	186	2.5	60% clay, 40% fine silt
LAB-PN-4-OLD-0-06	6/5/2018	0.156	25.7	25.7	6.97	6.93	64.7	95.4	4	10% fine sand, 10% clay, 80% fine silt
LAB-PN-4-OLD-0-07	8/30/2018	0.156	27	27	7.14	6.75	162	211	3.5	15% fine sand, 85% fine silt
LAB-PN-4-OLD-0-08	12/11/2018	0.156	2.2	2.2	15.82	14.98	251	248	5	45% clay, 45% fine sand, 10% fine silt
LAB-PN-4-CXLD-0-01	3/29/2017	0.156	13.4	13.4	10.2	9.9	56	54.3	4	94% fine silt, 5% fine sand, 1% clay
LAB-PN-4-CXLD-0-02	6/28/2017	0.156	26.1	26	5.21	4.98	139	168		85% coarse silt, 5% fine sand, 9% fine silt, 1% clay
LAB-PN-4-CXLD-0-03	9/20/2017	0.156	25.4	25.2	10.01	9.89	23.5	29.6		69% medium silt, 20% fine silt, 10% fine sand, 1% clay

Sample ID	Date	Total Effort	Surface Temp	Bottom Temp	Surface DO	Bottom DO	Surface Turbidity	Bottom Turbidity	Depth	Grain Size
LAB-PN-4-CXLD-0-05	3/14/2018	0.156	7.1	7.1	10.94	10.84	123	151	2.5	40% clay, 60% fine silt
LAB-PN-4-CXLD-0-06	6/5/2018	0.156	25.7	25.7	6.7	6.83	53.2	74.9	2.5	5% fine sand, 15% clay, 80% fine silt
LAB-PN-4-CXLD-0-07	8/30/2018	0.156	27	27	7.15	6.78	149	188	4	10% fine sand, 40% fine silt, 50% clay
LAB-PN-4-CXLD-0-08	12/11/2018	0.156	2.2	2.2	16.95	16.03	239	245	3	90% fine sand, 10% fine silt

Units for Water Quality Measurements: Temperature (°C), Dissolved Oxygen (mg/L), Turbidity (NTU), Depth (ft)
Total effort for Ponar samples were calculated in area sampled (m^2).

10. TOLERANCE

In MDNR Comment 9.d., data on heat-tolerant and heat-intolerant fish species were requested. Table 10-1 provides the data.

Table 10-1 Counts and weights of heat-intolerant, heat-tolerant, and heat-neutral (not in tolerant or intolerant categories) fishes for each combination of gear, zone, and season. Tolerant and intolerant species are listed individually. Neutral species are combined.

Gear	Zone	Season	Heat-Tolerance	Taxon	Total Count	Total Weight (kg)
BS	1	Winter	Neutral		660	0.2161
BS	1	Winter	Tolerant	Emerald shiner	76	0.0757
BS	1	Winter	Tolerant	Gizzard shad	5	0.0165
BS	1	Winter	Tolerant	River carpsucker	4	0.0133
BS	1	Spring	Intolerant	Goldeye	12	0.0114
BS	1	Spring	Intolerant	Sauger x Walleye	1	0.0005
BS	1	Spring	Neutral		193	0.3038
BS	1	Spring	Tolerant	Channel catfish	2	0.012
BS	1	Spring	Tolerant	Emerald shiner	34	0.0514
BS	1	Spring	Tolerant	Gizzard shad	7	0.0037
BS	1	Summer	Neutral		253	0.1022
BS	1	Summer	Tolerant	Emerald shiner	113	0.0539
BS	1	Summer	Tolerant	Gizzard shad	78	0.2219
BS	1	Summer	Tolerant	Longnose gar	1	0.542
BS	1	Fall	Neutral		3496	0.3696
BS	1	Fall	Tolerant	Emerald shiner	195	0.2331
BS	1	Fall	Tolerant	Gizzard shad	80	0.3421
BS	1	Fall	Tolerant	Longnose gar	1	0.675
BS	1	Fall	Tolerant	Silver carp	2	0.0021
BS	1	Fall	Tolerant	Smallmouth buffalo	8	0.0085
BS	3	Winter	Neutral		775	0.1404
BS	3	Winter	Tolerant	Emerald shiner	68	0.1114
BS	3	Winter	Tolerant	Gizzard shad	5	0.0244
BS	3	Spring	Intolerant	Goldeye	6	0.0049
BS	3	Spring	Intolerant	Sauger x Walleye	2	0.0021
BS	3	Spring	Neutral		184	0.1538
BS	3	Spring	Tolerant	Buffalofish	2	0.0007
BS	3	Spring	Tolerant	Channel catfish	11	0.0252
BS	3	Spring	Tolerant	Emerald shiner	58	0.101
BS	3	Spring	Tolerant	Flathead catfish	1	0.179
BS	3	Spring	Tolerant	Gizzard shad	40	0.0496
BS	3	Spring	Tolerant	Smallmouth buffalo	2	0.0049
BS	3	Summer	Intolerant	Goldeye	4	0.0175
BS	3	Summer	Neutral		338	0.1661

Gear	Zone	Season	Heat-Tolerance	Taxon	Total Count	Total Weight (kg)
BS	3	Summer	Tolerant	Channel catfish	1	0.0009
BS	3	Summer	Tolerant	Emerald shiner	290	0.161
BS	3	Summer	Tolerant	Gizzard shad	266	0.3316
BS	3	Summer	Tolerant	Smallmouth buffalo	1	0.0001
BS	3	Fall	Neutral		418	0.2576
BS	3	Fall	Tolerant	Channel catfish	4	0.0103
BS	3	Fall	Tolerant	Emerald shiner	250	0.2268
BS	3	Fall	Tolerant	Gizzard shad	37	0.2429
BS	3	Fall	Tolerant	Silver carp	3	0.0039
BS	4	Winter	Neutral		255	0.1016
BS	4	Winter	Tolerant	Emerald shiner	8	0.0061
BS	4	Winter	Tolerant	Gizzard shad	10	0.0418
BS	4	Spring	Intolerant	Goldeye	15	0.007
BS	4	Spring	Intolerant	Sauger x Walleye	10	0.0095
BS	4	Spring	Neutral		912	0.3748
BS	4	Spring	Tolerant	Buffalofish	1	0.0001
BS	4	Spring	Tolerant	Channel catfish	5	0.0039
BS	4	Spring	Tolerant	Emerald shiner	24	0.0288
BS	4	Spring	Tolerant	Gizzard shad	28	0.0703
BS	4	Spring	Tolerant	River carpsucker	2	1.181
BS	4	Spring	Tolerant	Smallmouth buffalo	1	0.0055
BS	4	Summer	Neutral		567	0.1447
BS	4	Summer	Tolerant	Buffalofish	3	0.0003
BS	4	Summer	Tolerant	Channel catfish	4	0.0021
BS	4	Summer	Tolerant	Emerald shiner	365	0.0844
BS	4	Summer	Tolerant	Gizzard shad	503	0.3865
BS	4	Summer	Tolerant	River carpsucker	1	0.0013
BS	4	Summer	Tolerant	Silver carp	11	0.0026
BS	4	Summer	Tolerant	Smallmouth buffalo	9	0.0041
BS	4	Fall	Neutral		813	0.265
BS	4	Fall	Tolerant	Channel catfish	2	0.017
BS	4	Fall	Tolerant	Emerald shiner	65	0.0599
BS	4	Fall	Tolerant	Gizzard shad	15	0.0843
BS	4	Fall	Tolerant	Silver carp	4	0.0046
BS	4	Fall	Tolerant	Smallmouth buffalo	3	0.0045
EF	1	Winter	Intolerant	Goldeye	10	0.333
EF	1	Winter	Intolerant	Sauger	1	0.7
EF	1	Winter	Intolerant	Walleye	2	3.328
EF	1	Winter	Intolerant	White crappie	1	0.48
EF	1	Winter	Neutral		175	156.4952

Gear	Zone	Season	Heat-Tolerance	Taxon	Total Count	Total Weight (kg)
EF	1	Winter	Tolerant	Bigmouth buffalo	1	1.77
EF	1	Winter	Tolerant	Channel catfish	5	2.76
EF	1	Winter	Tolerant	Emerald shiner	16	0.0274
EF	1	Winter	Tolerant	Gizzard shad	35	1.884
EF	1	Winter	Tolerant	Longnose gar	1	0.39
EF	1	Winter	Tolerant	River carpsucker	17	20.858
EF	1	Winter	Tolerant	Shortnose gar	1	0.81
EF	1	Winter	Tolerant	Silver carp	39	68.917
EF	1	Winter	Tolerant	Smallmouth buffalo	15	46.258
EF	1	Spring	Intolerant	Goldeye	5	0.0634
EF	1	Spring	Intolerant	White crappie	1	0.31
EF	1	Spring	Neutral		177	141.9878
EF	1	Spring	Tolerant	Bighead carp	2	1.31
EF	1	Spring	Tolerant	Channel catfish	9	4.921
EF	1	Spring	Tolerant	Emerald shiner	3	0.003
EF	1	Spring	Tolerant	Flathead catfish	11	2.678
EF	1	Spring	Tolerant	Gizzard shad	19	1.253
EF	1	Spring	Tolerant	Longnose gar	28	20.287
EF	1	Spring	Tolerant	River carpsucker	33	37.043
EF	1	Spring	Tolerant	Shortnose gar	22	14.3152
EF	1	Spring	Tolerant	Silver carp	3	5.717
EF	1	Spring	Tolerant	Smallmouth buffalo	14	28.677
EF	1	Summer	Intolerant	Goldeye	26	0.4158
EF	1	Summer	Intolerant	Walleye	2	0.0119
EF	1	Summer	Intolerant	White crappie	1	0.102
EF	1	Summer	Neutral		69	57.7442
EF	1	Summer	Tolerant	Channel catfish	24	4.1271
EF	1	Summer	Tolerant	Emerald shiner	37	0.037
EF	1	Summer	Tolerant	Flathead catfish	16	1.312
EF	1	Summer	Tolerant	Gizzard shad	131	2.7886
EF	1	Summer	Tolerant	Longnose gar	27	16.221
EF	1	Summer	Tolerant	River carpsucker	6	4.128
EF	1	Summer	Tolerant	Shortnose gar	18	11.744
EF	1	Summer	Tolerant	Silver carp	5	8.253
EF	1	Summer	Tolerant	Smallmouth buffalo	6	10.41
EF	1	Fall	Intolerant	Goldeye	11	0.573
EF	1	Fall	Intolerant	Mooneye	1	0.018
EF	1	Fall	Neutral		77	68.658
EF	1	Fall	Tolerant	Bigmouth buffalo	1	3.52
EF	1	Fall	Tolerant	Channel catfish	5	2.502

Gear	Zone	Season	Heat-Tolerance	Taxon	Total Count	Total Weight (kg)
EF	1	Fall	Tolerant	Emerald shiner	3	0.008
EF	1	Fall	Tolerant	Flathead catfish	1	0.2
EF	1	Fall	Tolerant	Gizzard shad	7	0.19
EF	1	Fall	Tolerant	Longnose gar	6	3.62
EF	1	Fall	Tolerant	River carpsucker	4	6.534
EF	1	Fall	Tolerant	Shortnose gar	9	7.53
EF	1	Fall	Tolerant	Silver carp	8	11.669
EF	1	Fall	Tolerant	Smallmouth buffalo	9	31.703
EF	2	Winter	Intolerant	Goldeye	5	1.445
EF	2	Winter	Intolerant	Sauger	1	0.0743
EF	2	Winter	Neutral		432	314.5466
EF	2	Winter	Tolerant	Channel catfish	12	13.9861
EF	2	Winter	Tolerant	Emerald shiner	10	0.0208
EF	2	Winter	Tolerant	Flathead catfish	5	14.691
EF	2	Winter	Tolerant	Gizzard shad	37	16.575
EF	2	Winter	Tolerant	Longnose gar	1	0.621
EF	2	Winter	Tolerant	River carpsucker	41	41.092
EF	2	Winter	Tolerant	Silver carp	4	7.316
EF	2	Winter	Tolerant	Smallmouth buffalo	10	39.43
EF	2	Spring	Neutral		68	130.1247
EF	2	Spring	Tolerant	Bighead carp	2	5.922
EF	2	Spring	Tolerant	Channel catfish	3	2.472
EF	2	Spring	Tolerant	Emerald shiner	21	0.024
EF	2	Spring	Tolerant	Flathead catfish	3	19.09
EF	2	Spring	Tolerant	Gizzard shad	11	4.203
EF	2	Spring	Tolerant	Longnose gar	25	16.94
EF	2	Spring	Tolerant	River carpsucker	7	6.385
EF	2	Spring	Tolerant	Shortnose gar	24	16.977
EF	2	Spring	Tolerant	Silver carp	8	24.827
EF	2	Spring	Tolerant	Smallmouth buffalo	5	9.001
EF	2	Summer	Intolerant	Goldeye	5	0.183
EF	2	Summer	Neutral		18	12.734
EF	2	Summer	Tolerant	Bighead carp	2	8.521
EF	2	Summer	Tolerant	Channel catfish	2	0.078
EF	2	Summer	Tolerant	Emerald shiner	12	0.014
EF	2	Summer	Tolerant	Flathead catfish	12	3.064
EF	2	Summer	Tolerant	Gizzard shad	5	0.01
EF	2	Summer	Tolerant	Longnose gar	5	3.411
EF	2	Summer	Tolerant	Shortnose gar	4	1.826
EF	2	Summer	Tolerant	Smallmouth buffalo	2	2.21

Gear	Zone	Season	Heat-Tolerance	Taxon	Total Count	Total Weight (kg)
EF	2	Fall	Intolerant	Goldeye	1	0.02
EF	2	Fall	Neutral		93	358.461
EF	2	Fall	Tolerant	Channel catfish	2	4.5
EF	2	Fall	Tolerant	Emerald shiner	16	0.035
EF	2	Fall	Tolerant	Flathead catfish	2	21.1
EF	2	Fall	Tolerant	Gizzard shad	3	1.65
EF	2	Fall	Tolerant	Longnose gar	4	2.79
EF	2	Fall	Tolerant	River carpsucker	19	19.47
EF	2	Fall	Tolerant	Shortnose gar	3	1.86
EF	2	Fall	Tolerant	Silver carp	1	1.52
EF	2	Fall	Tolerant	Smallmouth buffalo	2	7.02
EF	3	Winter	Intolerant	Goldeye	14	1.38
EF	3	Winter	Intolerant	Sauger	1	0.733
EF	3	Winter	Intolerant	Sauger x Walleye	1	0.1346
EF	3	Winter	Neutral		220	123.0555
EF	3	Winter	Tolerant	Bigmouth buffalo	1	1.599
EF	3	Winter	Tolerant	Channel catfish	7	2.85
EF	3	Winter	Tolerant	Emerald shiner	137	0.262
EF	3	Winter	Tolerant	Gizzard shad	154	16.0258
EF	3	Winter	Tolerant	Longnose gar	7	7.353
EF	3	Winter	Tolerant	River carpsucker	50	54.0144
EF	3	Winter	Tolerant	Shortnose gar	4	2.232
EF	3	Winter	Tolerant	Silver carp	42	72.054
EF	3	Winter	Tolerant	Smallmouth buffalo	16	42.545
EF	3	Spring	Intolerant	White crappie	2	0.381
EF	3	Spring	Neutral		140	107.6723
EF	3	Spring	Tolerant	Bigmouth buffalo	4	11.494
EF	3	Spring	Tolerant	Channel catfish	8	7.078
EF	3	Spring	Tolerant	Emerald shiner	16	0.0277
EF	3	Spring	Tolerant	Flathead catfish	12	3.881
EF	3	Spring	Tolerant	Gizzard shad	26	3.8384
EF	3	Spring	Tolerant	Longnose gar	39	21.013
EF	3	Spring	Tolerant	River carpsucker	23	25.023
EF	3	Spring	Tolerant	Shortnose gar	20	13.175
EF	3	Spring	Tolerant	Silver carp	25	55.381
EF	3	Spring	Tolerant	Smallmouth buffalo	17	29.357
EF	3	Summer	Intolerant	Goldeye	11	0.0931
EF	3	Summer	Intolerant	Mooneye	4	0.013
EF	3	Summer	Neutral		59	82.2826
EF	3	Summer	Tolerant	Bigmouth buffalo	1	4.422

Gear	Zone	Season	Heat-Tolerance	Taxon	Total Count	Total Weight (kg)
EF	3	Summer	Tolerant	Channel catfish	7	0.5334
EF	3	Summer	Tolerant	Emerald shiner	21	0.021
EF	3	Summer	Tolerant	Flathead catfish	23	18.3138
EF	3	Summer	Tolerant	Gizzard shad	82	0.2677
EF	3	Summer	Tolerant	Longnose gar	18	11.142
EF	3	Summer	Tolerant	River carpsucker	13	12.325
EF	3	Summer	Tolerant	Shortnose gar	18	11.921
EF	3	Summer	Tolerant	Silver carp	4	6.173
EF	3	Summer	Tolerant	Smallmouth buffalo	12	27.108
EF	3	Fall	Intolerant	Goldeye	16	0.637
EF	3	Fall	Neutral		96	152.14
EF	3	Fall	Tolerant	Bigmouth buffalo	1	5.69
EF	3	Fall	Tolerant	Channel catfish	3	1.455
EF	3	Fall	Tolerant	Emerald shiner	16	0.032
EF	3	Fall	Tolerant	Flathead catfish	5	0.662
EF	3	Fall	Tolerant	Gizzard shad	84	4.818
EF	3	Fall	Tolerant	Longnose gar	17	14.625
EF	3	Fall	Tolerant	River carpsucker	6	6.847
EF	3	Fall	Tolerant	Shortnose gar	33	22.5
EF	3	Fall	Tolerant	Silver carp	8	10.773
EF	3	Fall	Tolerant	Smallmouth buffalo	17	40.378
EF	4	Winter	Intolerant	Goldeye	4	0.223
EF	4	Winter	Intolerant	Walleye	1	0.372
EF	4	Winter	Intolerant	White crappie	1	0.1035
EF	4	Winter	Neutral		739	133.0696
EF	4	Winter	Tolerant	Bigmouth buffalo	1	1.437
EF	4	Winter	Tolerant	Channel catfish	1	4.63
EF	4	Winter	Tolerant	Emerald shiner	152	0.0428
EF	4	Winter	Tolerant	Flathead catfish	3	2.1
EF	4	Winter	Tolerant	Gizzard shad	128	2.4833
EF	4	Winter	Tolerant	Longnose gar	6	5.233
EF	4	Winter	Tolerant	River carpsucker	24	23.4284
EF	4	Winter	Tolerant	Shortnose gar	10	6.186
EF	4	Winter	Tolerant	Silver carp	61	56.95
EF	4	Winter	Tolerant	Smallmouth buffalo	9	21.314
EF	4	Spring	Intolerant	Goldeye	9	0.352
EF	4	Spring	Neutral		123	91.262
EF	4	Spring	Tolerant	Bigmouth buffalo	3	4.434
EF	4	Spring	Tolerant	Channel catfish	5	2.787
EF	4	Spring	Tolerant	Emerald shiner	10	0.0135

Gear	Zone	Season	Heat-Tolerance	Taxon	Total Count	Total Weight (kg)
EF	4	Spring	Tolerant	Flathead catfish	21	1.274
EF	4	Spring	Tolerant	Gizzard shad	21	1.415
EF	4	Spring	Tolerant	Longnose gar	23	14.321
EF	4	Spring	Tolerant	River carpsucker	22	23.967
EF	4	Spring	Tolerant	Shortnose gar	27	17.085
EF	4	Spring	Tolerant	Silver carp	19	42.155
EF	4	Spring	Tolerant	Smallmouth buffalo	4	15.795
EF	4	Summer	Intolerant	Goldeye	20	0.571
EF	4	Summer	Neutral		80	62.1898
EF	4	Summer	Tolerant	Channel catfish	10	3.902
EF	4	Summer	Tolerant	Emerald shiner	5	0.006
EF	4	Summer	Tolerant	Flathead catfish	29	2.067
EF	4	Summer	Tolerant	Gizzard shad	93	0.41
EF	4	Summer	Tolerant	Longnose gar	10	5.53
EF	4	Summer	Tolerant	River carpsucker	8	7.352
EF	4	Summer	Tolerant	Shortnose gar	13	9.21
EF	4	Summer	Tolerant	Silver carp	9	14.987
EF	4	Summer	Tolerant	Smallmouth buffalo	8	14.5
EF	4	Fall	Intolerant	Goldeye	10	0.729
EF	4	Fall	Intolerant	Mooneye	1	0.018
EF	4	Fall	Neutral		90	89.876
EF	4	Fall	Tolerant	Bigmouth buffalo	3	5.29
EF	4	Fall	Tolerant	Channel catfish	2	0.038
EF	4	Fall	Tolerant	Emerald shiner	5	0.0135
EF	4	Fall	Tolerant	Gizzard shad	105	3.213
EF	4	Fall	Tolerant	Longnose gar	11	7.48
EF	4	Fall	Tolerant	River carpsucker	12	13.702
EF	4	Fall	Tolerant	Shortnose gar	21	12.437
EF	4	Fall	Tolerant	Silver carp	8	16.22
EF	4	Fall	Tolerant	Smallmouth buffalo	14	29.57
HN	1	Winter	Intolerant	Sauger	1	0.59
HN	1	Winter	Neutral		25	35.455
HN	1	Winter	Tolerant	Channel catfish	1	0.4
HN	1	Winter	Tolerant	Silver carp	1	1.84
HN	1	Spring	Neutral		40	64.94
HN	1	Spring	Tolerant	River carpsucker	7	8.173
HN	1	Spring	Tolerant	Silver carp	2	4.8
HN	1	Spring	Tolerant	Smallmouth buffalo	2	4.45
HN	1	Summer	Neutral		23	36.492
HN	1	Summer	Tolerant	Bighead carp	1	3.922

Gear	Zone	Season	Heat-Tolerance	Taxon	Total Count	Total Weight (kg)
HN	1	Summer	Tolerant	Channel catfish	1	0.59
HN	1	Summer	Tolerant	Flathead catfish	3	6.94
HN	1	Summer	Tolerant	Longnose gar	2	3.82
HN	1	Summer	Tolerant	River carpsucker	3	3.27
HN	1	Summer	Tolerant	Smallmouth buffalo	9	22.69
HN	1	Fall	Intolerant	Goldeye	1	0.471
HN	1	Fall	Neutral		28	39.52
HN	1	Fall	Tolerant	Flathead catfish	1	3.43
HN	3	Winter	Intolerant	Goldeye	4	1.332
HN	3	Winter	Neutral		31	68.415
HN	3	Winter	Tolerant	Channel catfish	1	0.549
HN	3	Spring	Neutral		18	32.181
HN	3	Spring	Tolerant	Channel catfish	1	0.53
HN	3	Spring	Tolerant	Flathead catfish	4	14.82
HN	3	Spring	Tolerant	River carpsucker	1	1.203
HN	3	Spring	Tolerant	Silver carp	4	10.741
HN	3	Spring	Tolerant	Smallmouth buffalo	8	21.929
HN	3	Summer	Neutral		13	19.425
HN	3	Summer	Tolerant	Flathead catfish	1	2.25
HN	3	Summer	Tolerant	Longnose gar	3	8.12
HN	3	Summer	Tolerant	Smallmouth buffalo	4	8.96
HN	3	Fall	Intolerant	Goldeye	1	0.31
HN	3	Fall	Intolerant	Sauger x Walleye	1	0.6
HN	3	Fall	Neutral		13	21.998
HN	3	Fall	Tolerant	Bigmouth buffalo	2	5.178
HN	3	Fall	Tolerant	Flathead catfish	2	5.666
HN	3	Fall	Tolerant	River carpsucker	7	7.621
HN	3	Fall	Tolerant	Silver carp	1	2.261
HN	3	Fall	Tolerant	Smallmouth buffalo	7	16.73
HN	4	Winter	Intolerant	Goldeye	6	1.652
HN	4	Winter	Intolerant	Mooneye	1	0.22
HN	4	Winter	Intolerant	Sauger x Walleye	1	1.93
HN	4	Winter	Neutral		19	64.432
HN	4	Winter	Tolerant	Flathead catfish	1	1.008
HN	4	Winter	Tolerant	Gizzard shad	1	0.85
HN	4	Winter	Tolerant	River carpsucker	3	4.34
HN	4	Spring	Neutral		42	107.917
HN	4	Spring	Tolerant	Bighead carp	1	6.8
HN	4	Spring	Tolerant	Channel catfish	2	5.18
HN	4	Spring	Tolerant	Flathead catfish	2	4.614

Gear	Zone	Season	Heat-Tolerance	Taxon	Total Count	Total Weight (kg)
HN	4	Spring	Tolerant	Longnose gar	1	3.62
HN	4	Spring	Tolerant	River carpsucker	3	4.278
HN	4	Spring	Tolerant	Silver carp	1	1.65
HN	4	Spring	Tolerant	Smallmouth buffalo	5	13.926
HN	4	Summer	Neutral		16	38.793
HN	4	Summer	Tolerant	Bighead carp	1	11.42
HN	4	Summer	Tolerant	Flathead catfish	5	10.135
HN	4	Summer	Tolerant	Longnose gar	2	7.27
HN	4	Summer	Tolerant	River carpsucker	1	0.93
HN	4	Summer	Tolerant	Smallmouth buffalo	6	12.27
HN	4	Fall	Intolerant	Goldeye	6	1.744
HN	4	Fall	Neutral		25	34.127
HN	4	Fall	Tolerant	Channel catfish	1	1.07
HN	4	Fall	Tolerant	Flathead catfish	2	12.376
HN	4	Fall	Tolerant	River carpsucker	1	0.92
HN	4	Fall	Tolerant	Silver carp	3	5.53
HN	4	Fall	Tolerant	Smallmouth buffalo	1	3.188
MT	1	Winter	Neutral		192	3.3546
MT	1	Winter	Tolerant	Channel catfish	45	0.1758
MT	1	Winter	Tolerant	Gizzard shad	4	0.0338
MT	1	Winter	Tolerant	Shortnose gar	2	1.568
MT	1	Winter	Tolerant	Silver carp	4	4.881
MT	1	Spring	Intolerant	Goldeye	40	0.0054
MT	1	Spring	Intolerant	Mooneyes	1	0.0001
MT	1	Spring	Intolerant	Sauger x Walleye	7	0.0028
MT	1	Spring	Neutral		416	0.5909
MT	1	Spring	Tolerant	Channel catfish	54	0.3237
MT	1	Spring	Tolerant	Gizzard shad	89	0.0089
MT	1	Spring	Tolerant	Silver/bighead carp	4	0.0004
MT	1	Summer	Intolerant	Goldeye	8	0.0379
MT	1	Summer	Neutral		722	6.4016
MT	1	Summer	Tolerant	Buffalofish	4	0.0024
MT	1	Summer	Tolerant	Channel catfish	120	0.3347
MT	1	Summer	Tolerant	Flathead catfish	1	0.0001
MT	1	Summer	Tolerant	Gizzard shad	102	0.112
MT	1	Summer	Tolerant	Silver carp	54	0.0095
MT	1	Fall	Intolerant	Goldeye	2	0.055
MT	1	Fall	Neutral		683	3.6399
MT	1	Fall	Tolerant	Channel catfish	13	0.043
MT	1	Fall	Tolerant	Emerald shiner	18	0.0282

Gear	Zone	Season	Heat-Tolerance	Taxon	Total Count	Total Weight (kg)
MT	1	Fall	Tolerant	Silver carp	37	0.0186
MT	3	Winter	Neutral		266	1.0844
MT	3	Winter	Tolerant	Channel catfish	38	0.2291
MT	3	Winter	Tolerant	Emerald shiner	9	0.0114
MT	3	Winter	Tolerant	Gizzard shad	1	0.005
MT	3	Winter	Tolerant	Longnose gar	2	1.7
MT	3	Winter	Tolerant	Shortnose gar	6	4.024
MT	3	Winter	Tolerant	Silver carp	3	3.322
MT	3	Spring	Intolerant	Goldeye	26	0.0068
MT	3	Spring	Intolerant	Mooneyes	3	0.0004
MT	3	Spring	Intolerant	Sauger x Walleye	2	0.0006
MT	3	Spring	Neutral		476	6.7766
MT	3	Spring	Tolerant	Channel catfish	38	0.278
MT	3	Spring	Tolerant	Flathead catfish	1	0.006
MT	3	Spring	Tolerant	Gizzard shad	27	0.0027
MT	3	Summer	Intolerant	Goldeye	7	0.036
MT	3	Summer	Neutral		509	0.4387
MT	3	Summer	Tolerant	Channel catfish	65	0.0536
MT	3	Summer	Tolerant	Emerald shiner	2	0.002
MT	3	Summer	Tolerant	Gizzard shad	32	0.0716
MT	3	Summer	Tolerant	Shortnose gar	2	0.827
MT	3	Summer	Tolerant	Silver carp	48	0.0099
MT	3	Fall	Intolerant	Goldeye	1	0.029
MT	3	Fall	Neutral		945	5.4838
MT	3	Fall	Tolerant	Channel catfish	58	0.182
MT	3	Fall	Tolerant	Emerald shiner	47	0.0776
MT	3	Fall	Tolerant	Flathead catfish	1	0.478
MT	3	Fall	Tolerant	Gizzard shad	3	0.0085
MT	3	Fall	Tolerant	Shortnose gar	3	1.64
MT	3	Fall	Tolerant	Silver carp	29	1.2071
MT	4	Winter	Neutral		333	5.2265
MT	4	Winter	Tolerant	Channel catfish	32	0.2907
MT	4	Winter	Tolerant	Flathead catfish	1	0.004
MT	4	Winter	Tolerant	Gizzard shad	2	0.0146
MT	4	Winter	Tolerant	Longnose gar	1	1.035
MT	4	Winter	Tolerant	Silver carp	1	1.362
MT	4	Winter	Tolerant	Smallmouth buffalo	1	1.28
MT	4	Spring	Intolerant	Goldeye	60	0.0166
MT	4	Spring	Intolerant	Mooneye	2	0.0002
MT	4	Spring	Intolerant	Mooneyes	2	0.0003

Gear	Zone	Season	Heat-Tolerance	Taxon	Total Count	Total Weight (kg)
MT	4	Spring	Neutral		361	1.9461
MT	4	Spring	Tolerant	Buffalofish	1	0.0001
MT	4	Spring	Tolerant	Channel catfish	31	0.1385
MT	4	Spring	Tolerant	Emerald shiner	1	0.0025
MT	4	Spring	Tolerant	Gizzard shad	12	0.0012
MT	4	Spring	Tolerant	Longnose gar	1	0.647
MT	4	Spring	Tolerant	Silver/bighead carp	4	0.0004
MT	4	Summer	Intolerant	Goldeye	11	0.0387
MT	4	Summer	Neutral		532	0.7655
MT	4	Summer	Tolerant	Channel catfish	151	0.1176
MT	4	Summer	Tolerant	Flathead catfish	1	0.0001
MT	4	Summer	Tolerant	Gizzard shad	57	0.0609
MT	4	Summer	Tolerant	Longnose gar	1	0.41
MT	4	Summer	Tolerant	Silver carp	29	0.0085
MT	4	Summer	Tolerant	Silver/bighead carp	2	0.003
MT	4	Fall	Neutral		621	1.7891
MT	4	Fall	Tolerant	Channel catfish	10	0.026
MT	4	Fall	Tolerant	Emerald shiner	1	0.0007
MT	4	Fall	Tolerant	Gizzard shad	5	0.0156
MT	4	Fall	Tolerant	Silver carp	7	0.0058

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ATTACHMENT A: Evaluation of Dual Deployment of Hester Dendy Samplers

Evaluation of Dual Deployment of Hester Dendy Samplers

A total of 72,233 macroinvertebrates were collected from 298 Hester Dendy (H-D) samples over the two year sampling period from February 2017 through January 2018. Similar numbers of macroinvertebrates were collected in samplers suspended at mid-depth (n = 38,597 individuals; 53.4 percent of total) compared with bottom-depth (n = 33,636 individuals; 46.6 percent of total) (Table A-1). Mean densities of mid-depth and bottom-depth H-D samplers by season were similar among each sampling zone (Table A-2). While there was variability among seasons with higher densities in spring and summer, mid-depth H-D samplers typically had higher densities than bottom-depth samplers (Figure A-1). However, differences in mean densities observed among mid-depth and bottom-depth H-D samplers were not statistically significant (t-stat = -0.29, df = 30, p-value = 0.77). Despite differences in depth profile and the possibility for suspended H-D samplers to collect only drifting organisms versus those associated with the community that lives in the benthos, the overall taxonomic composition of H-D samplers was also very similar among depths (Table A-1). A Quantitative Similarity Index for Taxa (QSIT) value was calculated to compare the mid-depth and bottom-depth H-D samplers in terms of presence or absence of taxa, while also taking relative abundance (percent composition) into account (Shackleford 1988). The QSIT value was 87.14 for all locations combined over the two year sampling period, indicating that collections from mid-depth and bottom-depth samplers were essentially equal and representative of the same community (e.g. duplicate samples are expected to have a QSIT of 70 or greater, as determined in Rabeni et al. 1999). The QSIT value was also high when comparing mid-depth and bottom-depth samplers across sampling zones (upstream reference zone = 84.05; discharge zone = 77.91; thermally exposed zone = 83.07; downstream zone = 85.73). Consequently, the Final Demonstration results relied on a combined mid-depth and bottom-depth analysis of the H-D samplers, which accounts for the entire macroinvertebrate community (i.e. drift and benthos).

The top three most abundant taxa at both mid-depth and bottom-depth H-D samplers included the caddisfly genus *Hydropsyche* (27.5 and 23.6 percent of respective totals), the true fly genus *Rheotanytarsus* (17.6 and 15.5 percent, respectively), and the caddisfly *Potamyia flava* (8.9 and 12.7 percent, respectively) (Table A-1). Collectively, these three taxa accounted for 54 and 52 percent of the mid-depth and bottom-depth collections, respectively (Table A-1). These taxa also represented the top three taxa within each sampling zone for both mid-depth and bottom-depths (Table A-3 and C2-4). *Hydropsyche* spp. and *Potamyia flava* are filter feeders belonging to Hydropyschidae, the family of net-spinning caddisflies, and are often associated with big rivers having high silt loads and high concentrations of suspended organic substances (Wiggins 1998). Given their ability to tolerate heavy siltation and suspended materials, it is reasonable to expect high numbers would have been collected at both bottom and mid-depths, as was observed (Table A-1). Similarly, the non-biting midges (e.g. *Rheotanytarsus* spp.), which belong to the tribe Tanytarsini within the family Chironomidae, are also filter feeders that build their own cases. The high abundances of these species at both bottom and mid-depths is likely a result of the conditions present within the lower Missouri River (LMOR) including an increased amount of suspended particulates throughout the water column and bottom substrates ranging from fine silt to course sand with an abundant supply of material (i.e. fine sand) for larvae to build their cases.

Taxa that might be expected to comprise a major component of the LMOR drift (i.e. community sampled by mid-depth H-D samplers) included mayflies belonging to Baetidae (e.g.

Pseudocloeon spp.). These taxa frequently exhibit "fishlike" swimming behavior and use the main drift as a means to move to more optimal habitats and for the colonization of new habitats (Cummings et al. 2008; Thorp and Covich 2015). However, these taxa are primarily associated with the benthos and with fine sediments in depositional habitats where they feed. Based on bottom and mid-depth H-D collections made over the two year sampling period, slightly more individuals of Baetidae including *Pseudocloeon* spp. were collected in mid-depth (n = 3,149; 8.2 percent) than bottom-depth (n = 2,133; 6.3 percent) H-D samplers (Table A-1). This pattern was also maintained across each of the sampling zones (Table A-3 and C2-4).

Other mayflies belonging to the family Heptageniidae, the flat-headed mayflies, including *Maccaffertium mexicanum integrum* and *Heptagenia* spp., have behavioral and morphological adaptations for attachment to rocky surfaces and are known as clingers (Cummings et al. 2008). Based on these behaviors it might be expected for these taxa to exhibit a greater component of the benthic community than the main drift community potentially represented by the mid-depth H-D samplers. However, more individuals of these taxa were observed in mid-depth (n = 3,218; 8.3 percent) than bottom-depth (n = 1,881; 5.6 percent) H-D samplers (Table A-1). This pattern was also consistent across sampling zones (Table A-3 and C2-4). The placement of H-D arrays in close proximity to rock dike structures may provide a possible explanation for the increased occurrence of these taxa in mid-depth samplers. Other taxa that display similar clinging behavior and are also characterized as crawlers (i.e. these taxa main means of locomotion is moving slowly along the bottom) include members of the family Perlidae (e.g. *Acroneuria* spp., *Perlesta* spp., *Neoperla* spp.) (Cummings et al. 2008). These taxa might be expected to represent a larger component of the benthic community (i.e. bottom H-D samplers) than the drift community based on their behavior and morphological adaptations. However, the data show a nearly equal component of these taxa combined in mid-depth (n = 222; 0.6 percent) and bottom-depth (n = 187; 0.6 percent) H-D samplers (Table A-1). Individually, *Perlesta* spp. were more abundant in mid-depth H-D samplers, while *Acroneuria* spp. and *Neoperla* spp. were slightly more abundant in bottom H-D samplers (Table A-1). This pattern was also generally consistent across sampling zones for these taxa (Table A-3 and C2-4).

There were several taxa that were only collected in mid-depth H-D samplers over the two year sampling period, though they occurred in very low abundance (<0.2 percent of mid-depth samples for all taxa combined; Table A-5). Similarly, there were some taxa occasionally collected only in bottom-depth H-D samplers (<0.1 percent of bottom-depth samples for all taxa combined; Table A-6). Thus, all of these occurrences reflect taxa that were infrequently collected during the two year sampling period and not taxa that may be preferential to either the benthic community or the drift community.

Diversity metrics including taxa richness (^0D), Shannon diversity (^1D), and Simpson diversity (^2D) were also similar among mid-depth and bottom-depth H-D samplers by season among each of the sampling zones (Winter – Figure A-2; Summer – Figure A-3). Slight differences in diversity metrics were observed for individual sampling zones (e.g. the upstream reference zone in winter and the thermally exposed zone in summer); however, overall, they showed a very similar pattern as the sensitivity to abundance (q) increased (Figures C2-2 and C2-3). The Biotic Index (BI) of mid-depth and bottom-depth H-D samplers was also similar among each of the sampling zones during each season (Table A-7). While slightly lower BI values were observed in the spring for each of the sampling zones, the BI values were relatively consistent, ranging from 4.22 in the discharge zone in spring to 5.51 for the upstream reference zone in summer (Table A-7). Overall, no statistically significant differences were observed among BI values for mid-depth and bottom-depth H-D samplers (t-stat = -0.47, df = 30, p-value = 0.64)

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Table A-1. Number of each Species Collected by Mid-Depth and Bottom-Depth Hester Dendy Samplers during 2017-2018 Surveys near Labadie Energy Center

Taxonomic Group	Scientific Name	Mid-Depth		Bottom-Depth		Combined Total	Percent of Combined Total
		Total Number Collected	Percent of Total	Total Number Collected	Percent of Total		
TR	*Hydropsyche* spp.	10,601	27.47	7,948	23.63	18,549	25.68
DI	*Rheotanytarsus* spp.	6,775	17.55	5,213	15.50	11,988	16.60
TR	*Potamyia flava*	3,460	8.96	4,273	12.70	7,733	10.71
DI	*Stenochironomus* spp.	2,303	5.97	2,817	8.37	5,120	7.09
TR	Hydropsychidae	2,047	5.30	2,518	7.49	4,565	6.32
EP	*Pseudocloeon* spp.	2,500	6.48	1,727	5.13	4,227	5.85
DI	*Polypedilum flavum*	1,851	4.80	1,469	4.37	3,320	4.60
EP	*Maccaffertium mexicanum integrum*	1,973	5.11	1,136	3.38	3,109	4.30
EP	*Amercaenis* spp.	1,503	3.89	1,067	3.17	2,570	3.56
EP	Heptageniidae	980	2.54	591	1.76	1,571	2.17
EP	Baetidae	649	1.68	406	1.21	1,055	1.46
DI	Chironomidae	353	0.91	525	1.56	878	1.22
IN	Insecta*	379	0.98	488	1.45	867	1.20
EP	*Isonychia* spp.	274	0.71	313	0.93	587	0.81
DI	*Polypedilum scalaenum* group	229	0.59	216	0.64	445	0.62
EP	*Heptagenia* spp.	265	0.69	154	0.46	419	0.58
TR	*Neureclipsis* spp.	152	0.39	222	0.66	374	0.52
EP	*Caenis* spp.	177	0.46	151	0.45	328	0.45
DI	*Polypedilum* spp.	55	0.14	244	0.73	299	0.41
DI	*Telopelopia okoboji*	107	0.28	121	0.36	228	0.32
PL	*Perlesta* spp.	121	0.31	50	0.15	171	0.24
DI	*Tanytarsini*	55	0.14	112	0.33	167	0.23
OD	*Argia* spp.	54	0.14	98	0.29	152	0.21

Table A-1 (cont.). Number of each Species Collected by Mid-Depth and Bottom-Depth Hester Dendy Samplers during 2017-2018 Surveys near Labadie Energy Center

Taxonomic Group	Scientific Name	Mid-Depth		Bottom-Depth		Combined Total	Percent of Combined Total
		Total Number Collected	Percent of Total	Total Number Collected	Percent of Total		
DI	*Thienemannimyia* sp. group	76	0.20	74	0.22	150	0.21
EP	*Isonychia rufa*	91	0.24	57	0.17	148	0.20
EP	*Tricorythodes* spp.	81	0.21	58	0.17	139	0.19
PL	*Neoperla* spp.	51	0.13	74	0.22	125	0.17
EP	Ephemeroptera	82	0.21	40	0.12	122	0.17
PL	*Acroneuria* spp.	50	0.13	63	0.19	113	0.16
DI	*Kribiodorum perpulchrum*	43	0.11	69	0.21	112	0.16
NA	All Other Non-Dominant Taxa	1,260	3.26	1,342	3.99	2,602	3.60
Totals		**38,597**	**53.43**	**33,636**	**46.57**	**72,233**	**100.00**

* Insect group comprised mostly of unknown insect eggs

Table A-2. Mean Density of Hester Dendy Samplers by Depth by Season in each Sampling Zone during 2017-2018 Surveys near Labadie Energy Center

Gear Type	Season	Statistic*	Sampling Zone: Upstream Reference	Discharge	Thermally Exposed	Downstream
Hester Dendy Bottom-Depth	Winter	Mean	15.32	93.84	36.30	21.69
		Std Err	2.16	32.28	12.61	4.96
		N	11	4	12	12
	Spring	Mean	517.6	1212.7	565.7	760.4
		Std Err	117.8	184.72	225.1	160.0
		N	12	3	7	9
	Summer	Mean	527.7	1227.4	632.9	236.6
		Std Err	304.1	757.51	389.9	72.55
		N	12	4	12	11
	Fall	Mean	44.29	236.30	72.83	35.49
		Std Err	9.00	144.59	19.88	7.15
		N	12	4	12	11
Hester Dendy Mid-Depth	Winter	Mean	23.52	113.70	43.84	24.54
		Std Err	3.53	47.35	12.05	5.23
		N	12	4	12	12
	Spring	Mean	693.4	1280.4	644.8	792.0
		Std Err	138.5	509.74	141.3	195.2
		N	11	4	7	9
	Summer	Mean	566.1	1370.5	742.4	255.6
		Std Err	254.4	757.59	393.1	40.02
		N	11	4	12	11
	Fall	Mean	68.26	156.85	95.66	74.77
		Std Err	29.29	62.72	27.69	12.99
		N	12	4	12	12

* Mean density = number of organisms/0.1 m^2, Std Err = standard error of mean, N = number of samples

Table A-3. Number of each Species Collected by Mid-Depth Hester Dendy Samplers in each Sampling Zone during 2017-2018 Surveys near Labadie Energy Center

Taxonomic Group	Scientific Name	Upstream Zone		Discharge Zone		Thermally Exposed Zone		Downstream Zone	
		Total Number Collected	Percent of Total	Total Number Collected	Percent of Total	Total Number Collected	Percent of Total	Total Number Collected	Percent of Total
TR	*Hydropsyche* spp.	2,161	19.79	4,247	49.78	2,712	24.61	1,481	18.22
DI	*Rheotanytarsus* spp.	2,488	22.79	718	8.42	2,810	25.50	759	9.34
TR	*Potamyia flava*	805	7.37	746	8.74	1,003	9.10	906	11.15
DI	*Stenochironomus* spp.	571	5.23	80	0.94	776	7.04	876	10.78
TR	Hydropsychidae	632	5.79	490	5.74	451	4.09	474	5.83
EP	*Pseudocloeon* spp.	788	7.22	666	7.81	478	4.34	568	6.99
DI	*Polypedilum flavum*	533	4.88	397	4.65	534	4.85	387	4.76
EP	*Maccaffertium mexicanum integrum*	679	6.22	140	1.64	603	5.47	551	6.78
EP	*Amercaenis* spp.	376	3.44	400	4.69	233	2.11	494	6.08
EP	Heptageniidae	350	3.21	68	0.80	255	2.31	307	3.78
EP	Baetidae	247	2.26	88	1.03	127	1.15	187	2.30
DI	Chironomidae	101	0.93	32	0.38	51	0.46	169	2.08
IN	Insecta*	107	0.98	42	0.49	112	1.02	118	1.45
EP	*Isonychia* spp.	127	1.16	34	0.40	57	0.52	56	0.69
DI	*Polypedilum scalaenum* group	97	0.89	0	0.00	54	0.49	78	0.96
EP	*Heptagenia* spp.	56	0.51	80	0.94	51	0.46	78	0.96
TR	*Neureclipsis* spp.	60	0.55	2	0.02	62	0.56	28	0.34
EP	*Caenis* spp.	70	0.64	4	0.05	42	0.38	61	0.75
DI	*Polypedilum* spp.	32	0.29	0	0.00	4	0.04	19	0.23
DI	*Telopelopia okoboji*	43	0.39	6	0.07	51	0.46	7	0.09
PL	*Perlesta* spp.	34	0.31	34	0.40	17	0.15	36	0.44
DI	*Tanytarsini*	19	0.17	12	0.14	11	0.10	13	0.16
OD	*Argia* spp.	12	0.11	0	0.00	22	0.20	20	0.25

Table A-3 (cont.). Number of each Species Collected by Mid-Depth Hester Dendy Samplers in each Sampling Zone during 2017-2018 Surveys near Labadie Energy Center

Taxonomic Group	Scientific Name	Upstream Zone		Discharge Zone		Thermally Exposed Zone		Downstream Zone	
		Total Number Collected	Percent of Total	Total Number Collected	Percent of Total	Total Number Collected	Percent of Total	Total Number Collected	Percent of Total
DI	*Thienemannimyia* sp. group	25	0.23	0	0.00	19	0.17	32	0.39
EP	*Isonychia rufa*	48	0.44	10	0.12	18	0.16	15	0.18
EP	*Tricorythodes* spp.	38	0.35	4	0.05	18	0.16	21	0.26
PL	*Neoperla* spp.	17	0.16	1	0.01	13	0.12	20	0.25
EP	Ephemeroptera	13	0.12	56	0.66	1	0.01	12	0.15
PL	*Acroneuria* spp.	24	0.22	1	0.01	19	0.17	6	0.07
DI	*Kribiodorum perpulchrum*	15	0.14	0	0.00	9	0.08	19	0.23
NA	All Other Non-Dominant Taxa	350	3.21	173	2.03	408	3.70	329	4.05
Totals		**10,918**	**100**	**8,531**	**100**	**11,021**	**100**	**8,127**	**100**

* Insect group comprised mostly of unknown insect eggs

Table A-4. Number of each Species Collected by Bottom-Depth Hester Dendy Samplers in each Sampling Zone during 2017-2018 Surveys near Labadie Energy Center

Taxonomic Group	Scientific Name	Upstream Zone		Discharge Zone		Thermally Exposed Zone		Downstream Zone	
		Total Number Collected	Percent of Total	Total Number Collected	Percent of Total	Total Number Collected	Percent of Total	Total Number Collected	Percent of Total
TR	*Hydropsyche* spp.	1,369	14.16	2,628	36.48	2,759	29.38	1,192	16.17
DI	*Rheotanytarsus* spp.	2,273	23.51	671	9.31	1,494	15.91	775	10.51
TR	*Potamyia flava*	846	8.75	1,302	18.07	1,275	13.58	850	11.53
DI	*Stenochironomus* spp.	871	9.01	168	2.33	817	8.70	961	13.04
TR	Hydropsychidae	758	7.84	1,072	14.88	341	3.63	347	4.71
EP	*Pseudocloeon* spp.	562	5.81	421	5.84	367	3.91	377	5.11
DI	*Polypedilum flavum*	310	3.21	274	3.80	360	3.83	525	7.12
EP	*Maccaffertium mexicanum integrum*	360	3.72	115	1.60	405	4.31	256	3.47
EP	*Amercaenis* spp.	270	2.79	188	2.61	66	0.70	543	7.37
EP	Heptageniidae	210	2.17	52	0.72	189	2.01	140	1.90
EP	Baetidae	152	1.57	42	0.58	58	0.62	154	2.09
DI	Chironomidae	154	1.59	22	0.31	85	0.91	264	3.58
IN	Insecta*	65	0.67	0	0.00	138	1.47	285	3.87
EP	*Isonychia* spp.	151	1.56	14	0.19	117	1.25	31	0.42
DI	*Polypedilum scalaenum* group	83	0.86	2	0.03	64	0.68	67	0.91
EP	*Heptagenia* spp.	50	0.52	32	0.44	49	0.52	23	0.31
TR	*Neureclipsis* spp.	92	0.95	2	0.03	85	0.91	43	0.58
EP	*Caenis* spp.	51	0.53	2	0.03	57	0.61	41	0.56
DI	*Polypedilum* spp.	196	2.03	12	0.17	22	0.23	14	0.19
DI	*Telopelopia okoboji*	37	0.38	6	0.08	65	0.69	13	0.18
PL	*Perlesta* spp.	11	0.11	6	0.08	15	0.16	18	0.24
DI	*Tanytarsini*	64	0.66	20	0.28	8	0.09	20	0.27

Table A-4 (cont.). Number of each Species Collected by Bottom-Depth Hester Dendy Samplers in each Sampling Zone during 2017-2018 Surveys near Labadie Energy Center

Taxonomic Group	Scientific Name	Upstream Zone		Discharge Zone		Thermally Exposed Zone		Downstream Zone	
		Total Number Collected	Percent of Total	Total Number Collected	Percent of Total	Total Number Collected	Percent of Total	Total Number Collected	Percent of Total
OD	*Argia* spp.	17	0.18	0	0.00	54	0.57	27	0.37
DI	*Thienemannimyia* sp. group	13	0.13	2	0.03	35	0.37	24	0.33
EP	*Isonychia rufa*	18	0.19	10	0.14	27	0.29	2	0.03
EP	*Tricorythodes* spp.	22	0.23	6	0.08	15	0.16	15	0.20
PL	*Neoperla* spp.	20	0.21	2	0.03	36	0.38	16	0.22
EP	Ephemeroptera	22	0.23	5	0.07	3	0.03	10	0.14
PL	*Acroneuria* spp.	30	0.31	8	0.11	11	0.12	14	0.19
DI	*Kribiodorum perpulchrum*	22	0.23	4	0.06	15	0.16	28	0.38
NA	All Other Non-Dominant Taxa	570	5.90	116	1.61	360	3.83	296	4.02
Totals		**9,669**	**100**	**7,204**	**100**	**9,392**	**100**	**7,371**	**100**

* Insect group comprised mostly of unknown insect eggs

Table A-5. Species Collected only by Mid-Depth Hester Dendy Samplers during 2017-2018 Surveys near Labadie Energy Center

Taxonomic Group	Scientific Name	Total Number Collected	Percent of Mid-Depth	Overall Percent of Total
OL	*Aulodrilus pluriseta*	1	0.003	0.001
OL	*Limnodrilus udekemianus*	3	0.008	0.004
CO	*Ancyronyx variegata*	2	0.005	0.003
CO	*Macronychus glabratus*	1	0.003	0.001
DI	*Bezzia/Palpomyia* spp.	2	0.005	0.003
DI	*Sphaeromias* sp.	1	0.003	0.001
DI	*Hemerodromia* sp.	1	0.003	0.001
DI	*Simulium* spp.	4	0.010	0.006
DI	*Ablabesmyia annulata*	5	0.013	0.007
DI	*Cricotopus* spp.	4	0.010	0.006
DI	*Cricotopus bicinctus*	15	0.039	0.021
DI	*Cricotopus sylvestris* group	4	0.010	0.006
DI	*Eukiefferiella claripennis* group	1	0.003	0.001
DI	*Micropsectra* spp.	8	0.021	0.011
DI	*Paratanytarsus* spp.	2	0.005	0.003
EP	*Hexagenia limbata*	1	0.003	0.001
EP	*Maccaffertium exiguum*	8	0.021	0.011
EP	*Raptoheptagenia cruentata*	1	0.003	0.001
EP	*Spinadis simplex*	2	0.005	0.003
EP	*Stenonema femoratum*	1	0.003	0.001
OD	*Didymops* spp.	2	0.005	0.003
OD	*Coenagrion/Enallagma* sp.	1	0.003	0.001

Table A-6. Species Collected only by Bottom-Depth Hester Dendy Samplers during 2017-2018 Surveys near Labadie Energy Center

Taxonomic Group	Scientific Name	Total Number Collected	Percent of Bottom-Depth	Overall Percent of Total
TU	Trepaxonemata	1	0.003	0.001
HI	*Helobdella austinensis*	2	0.006	0.003
OL	*Pristina longiseta*	1	0.003	0.001
DI	Tabanidae	4	0.012	0.006
DI	*Labrundinia pilosella*	4	0.012	0.006
DI	*Procladius (Psilotanypus)* sp.	1	0.003	0.001
DI	*Corynoneura floridaensis*	1	0.003	0.001
DI	*Nanocladius minimus*	1	0.003	0.001
DI	*Tvetenia vitracies*	2	0.006	0.003
DI	*Axarus* sp.	1	0.003	0.001
DI	*Cryptotendipes* sp.	1	0.003	0.001
DI	*Robackia claviger*	1	0.003	0.001
DI	*Rheotanytarsus exigus* group	1	0.003	0.001
EP	*Pentagenia vittigera*	2	0.006	0.003
EP	*Ephoron album*	3	0.009	0.004

Table A-7. Biotic Index of Hester Dendy Samplers by Depth by Season in each Sampling Zone during 2017-2018 Surveys near Labadie Energy Center

Gear Type	Season	Statistic	Sampling Zone: Upstream Reference	Discharge	Thermally Exposed	Downstream
Hester-Dendy Mid-Depth	Winter	Biotic Index	4.38	5.16	4.61	4.95
	Spring	Biotic Index	4.41	4.24	4.40	4.52
	Summer	Biotic Index	5.46	4.47	5.13	4.79
	Fall	Biotic Index	4.82	4.35	4.82	4.87
Hester-Dendy Bottom-Depth	Winter	Biotic Index	4.62	4.95	5.07	4.82
	Spring	Biotic Index	4.43	4.22	4.43	4.72
	Summer	Biotic Index	5.51	4.62	4.79	4.79
	Fall	Biotic Index	4.75	4.58	4.90	5.03

Note: Biotic Index values from 3.51-4.50 indicate very good water quality with possible slight organic pollution. Biotic index values from 4.51-5.50 indicate good water quality with some organic pollution.

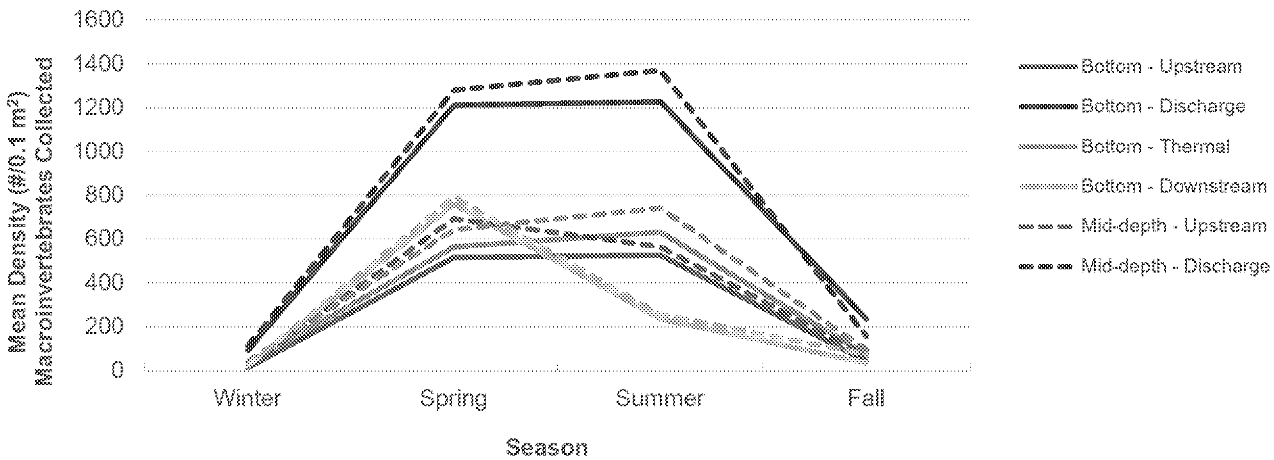

Figure A-1. Mean Density of Hester Dendy Samplers by Depth by Season in each Sampling Zone during 2017-2018 Surveys near Labadie Energy Center

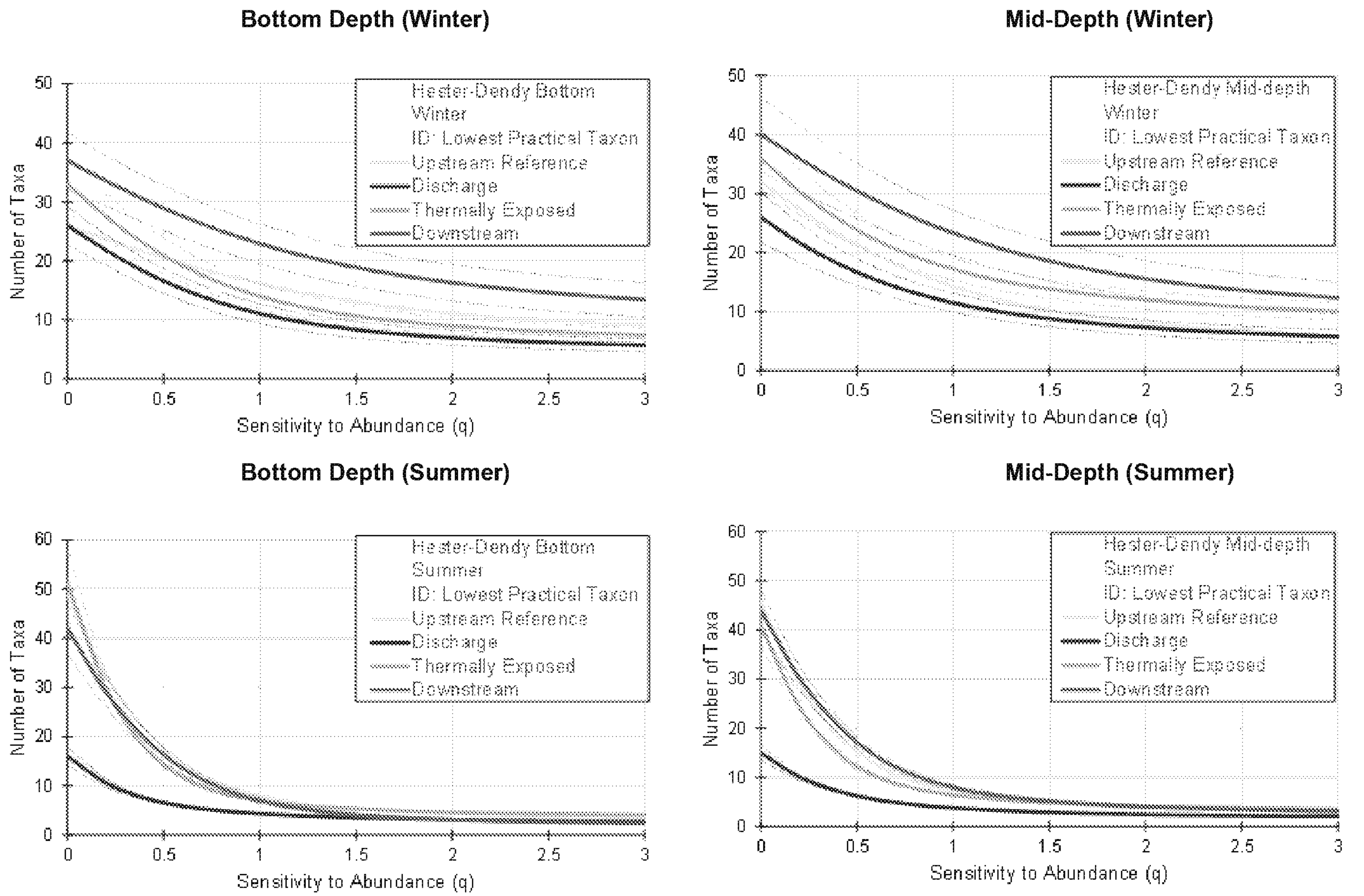

Figure A-2. Diversity Profiles of Hester Dendy Samplers by Depth in each Sampling Zone during Winter (Top Panels) and Summer (Bottom Panels) during 2017-2018 Surveys near Labadie Energy Center